



RESPIRATORY SYSTEM

www.kdhe.state.ks.us/c-f/special_needs_part2.html



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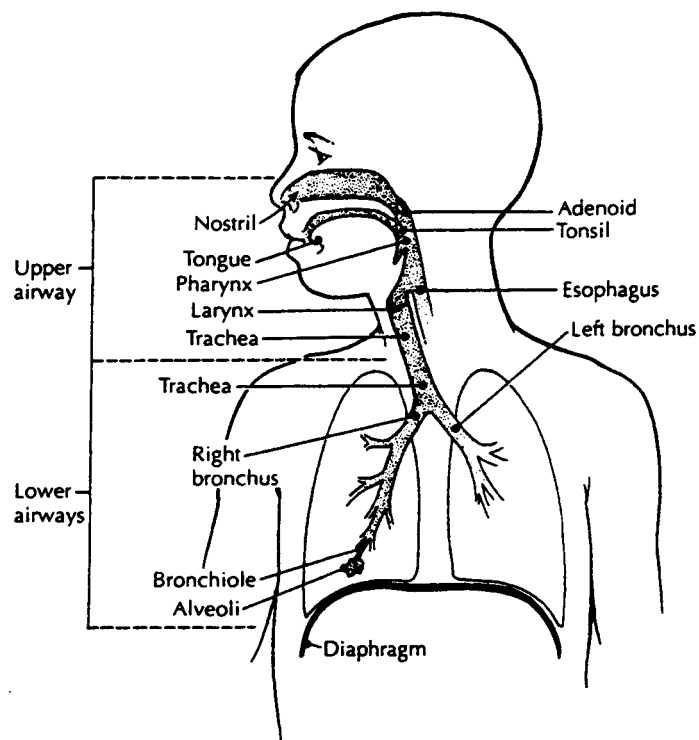
Respiratory System¹

STRUCTURE AND FUNCTION

The primary function of the respiratory system is the exchange of gases in the air with gases dissolved in the blood. Oxygen from the air is transferred to the blood, and carbon dioxide from the blood is removed to the air. Effective and efficient transfer of gases depends on all of the parts of the respiratory system. Chronic or acute disease of any of these parts may impair gas exchange. There are several parts to the respiratory system.

In the *upper airway*, air enters the lungs through the nose and mouth to reach the *pharynx* (i.e., back of the throat) and passes through the *larynx* (i.e., voice box) and into the *trachea* (i.e., windpipe).

As air enters the nose, hairs in the nostrils filter out the larger dust particles. Air then passes through the nose, where a large area of moist mucus membrane adds moisture and warms the air to body temperature. Air then passes through the larynx and down into the trachea. This passage of air through the larynx during inhalation (i.e., breathing in) and exhalation (i.e., breathing out) is necessary for normal speech production. *Mucus* comes from the tissues that line both the upper and lower airways. If mucus is not warmed and humidified, it can dry and thicken or harden, causing a blockage in the airway.



In the *lower airways*, the trachea divides into the two main *bronchi*. Each bronchus then subdivides into smaller bronchi, which in turn divide. This division into smaller and smaller airways continues many times. Finally, the *bronchioles* (i.e., small bronchi) end in the *alveoli*, where the exchange of oxygen and carbon dioxide takes place. The bronchi are lined with mucus and are covered with *cilia* (i.e., tiny hairs) that help remove particles of dust. All but the smallest airways also are surrounded by smooth muscle and can tighten and narrow if irritated (e.g., as in asthma).

Gas exchange takes place in the alveolus. The alveolus is only one cell thick. It is in contact with the blood so gas can diffuse from the blood to the alveolus or from the alveolus to the blood.

The *diaphragm* and *intercostal* muscles are the main muscles for normal breathing. The diaphragm is located below the lungs and is attached to the lower ribs and the spine. When it contracts, it pulls down, and air enters the respiratory system. The intercostal muscles connect nearby ribs and help to expand the lungs so air can enter the respiratory system.

The *heart* pumps blood to the lungs and to the body. If there is heart disease or disease of the blood vessels in the lungs, gas exchange may not be adequate, and the patient may require extra oxygen (see pp. 259-270).

DISORDERS AFFECTING THE RESPIRATORY SYSTEM

Diseases may affect any of the parts of the respiratory system and lead to ineffective gas exchange. Disorders that may chronically impair the respiratory system can be divided into several major categories. A student may be affected by one or more of these disorders. It is helpful, however, to think in terms of the major systems affected. Ongoing support of the respiratory system ranges from supplemental oxygen to full mechanical ventilation through a tracheostomy tube. How much support a person needs is a function of the major system involved and the severity of the disease. The following are some examples:

1. Disorders that affect the stimulus to breathe
 - Brain damage from trauma, drowning, suffocation, or difficulties at birth
 - Certain progressive neurological diseases
2. Disorders that affect the strength of the respiratory muscles
 - Progressive degenerative muscle diseases such as muscular dystrophy or spinal cord injuries
3. Disorders that affect the upper airway
 - Structural abnormalities of the oral or nasal cavity (e.g., cleft palate, choanal atresia [blocked nasal passages])
 - Abnormal development of the facial bones or muscles
 - Disorders affecting the normal coordination of the swallowing mechanism and the mechanisms that protect the airway from food or liquid
 - Conditions such as muscular dystrophy, brain damage, or progressive neurological diseases, which interfere with normal function of the esophagus
 - Abnormalities of the larynx, trachea, or bronchi, such as stenoses (narrowing), blockage (by tumor or swelling), or abnormally floppy airways
4. Disorders affecting the lower airways
 - Swelling, scarring, and other structural blockages in the trachea
 - Cystic fibrosis, which causes increased amounts of thick mucus in the lungs and airway
 - Asthma, which may also necessitate chronic oxygen use
5. Disorders of the alveoli
 - Pneumonia
 - Bronchopulmonary dysplasia
 - Pulmonary toxicity from cancer chemotherapy

NEBULIZER TREATMENTS

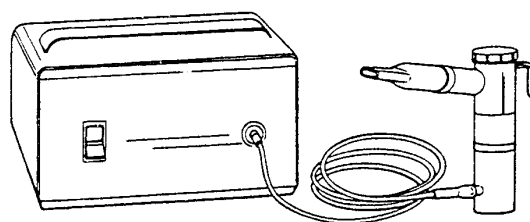
PURPOSE

Nebulizer treatments deliver medication in mist form directly into the lungs. When air from the compressor (i.e., air pump) is pushed through the tubing and into the medicine chamber (i.e., nebulizer cup), the medicine breaks up into a mist that the student inhales. Small dosages of medication inhaled directly into the lungs cause fewer side effects than the same medication taken in oral form. Medication by nebulizer also reaches the bronchioles more rapidly, and less coordination and breathing effort are required than when using a metered dose inhaler.

Aerosol treatments are beneficial for children who are too young to master the metered dose inhaler and for students with moderate to severe asthma whose lung function is greatly impaired. Nebulizer treatments also are used to deliver antibiotics and other medications.

SUGGESTED SETTINGS

Select an area such as a health room or office for privacy. The air compressor may be moderately noisy. A *nebulizer unit* is attached to the air outlet on the compressor. It consists of the *nebulizer cup*, which holds the medicine, and the *nebulizer*, which produces the mist. A *T adaptor*, placed on the nebulizer, passes air to the mouthpiece and allows exhaled air to pass out.



The *mouthpiece* is placed between the teeth and allows for a tight seal with the lips. A *face mask* or a *tracheostomy mask* can be used instead of a mouthpiece and attaches directly to the nebulizer unit. The *connecting tubing* connects from the end of the nebulizer unit to the air outlet of the compressor.

Note: Nebulizer units vary in design, which affects the size and speed of the mist particles and length of treatment. Some units are more durable and can withstand greater use and cleaning.

A *power-driven air compressor* is available in different models. All have the same basic features: an *air outlet*, to which the nebulizer tubing is connected; and an *air inlet*, which pulls air into the compressor through a *filter*.

The filter needs to be kept clean and should be replaced periodically.

SUGGESTED PERSONNEL AND TRAINING

A health care assessment must be completed by the school nurse. State nurse regulations should be consulted for guidance on delegating health care procedures.

A nebulizer treatment may be administered by the school nurse, family, teacher, student aide, or other person with proven competency-based training in appropriate techniques and problem management. Before deciding on the appropriate person to administer the treatment, information about state regulations and school policy for medication administration in school must be considered. Medication administration protection measures (e.g., use of filters in the exhalation port, tightly fitting mask during treatment), if indicated, also should be followed. The student should be encouraged to assist with the nebulizer treatment as much as possible. Any school personnel who have regular contact with a student who requires a nebulizer treatment should receive general training that covers the student's specific health care needs, potential problems, and how to implement the established emergency plan.

The basic skills checklist on pp. 10-11 can be used as a foundation for competency-based training in appropriate techniques. It outlines the procedure step by step. Once the procedures have been mastered, the completed checklist serves as documentation of training.

THE INDIVIDUALIZED HEALTH CARE PLAN: ISSUES FOR SPECIAL CONSIDERATION

Each student's individualized health care plan (IHCP) must be tailored to the individual's needs. The following section covers the procedures for nebulizer treatment and possible problems and emergencies that may arise. It is essential to review it before writing the IHCP.

A sample plan is included in this manual. It may be copied and used to develop a plan for each student. For a student who requires nebulizer treatment, the following should receive particular attention:

- Need for student to receive nebulizer treatment
- Need for activity modifications
- Knowledge of guidelines and protective measures specific to the medications being administered
- Knowledge of allergens and triggers of wheezing for students with asthma
- Student's self-care skills
- Student's school attendance/absences related to increase in episodes of respiratory distress
- Need for peak flow readings before treatment
- Student's knowledge of early signs of respiratory distress
- Need for chest physical therapy and/or suctioning
- Treatment administration as "regularly schedule" or "treatment as needed"
- Response to treatment and necessity for repeat treatments (per physician) or nurse practitioner's order)
- Latex allergy alert
- Universal precautions (anticipating the tasks to be done, the risk involved, or the personal protective equipment needed will enhance protection of both the caregiver and student)

Problems that Require Attention for Students Requiring Nebulizer Treatment

Observation	Reason/Action
Tightness in chest Coughing Wheezing Shortness of breath Retractions (i.e., pulling in of rib cage) Cough or wheeze gets worse	<i>Give nebulizer treatment according to physician's orders. Most inhaled bronchodilator medicines produce an effect within 5-10 minutes.</i>
Breathing gets increasingly difficult	<i>Stay calm. Reassure student. Document vital signs.</i>
Struggling to breathe or hunching over after treatment is finished.	<i>Follow student-specific emergency plan. Notify school nurse, family, and physician.</i>

Possible Problems that Are Not Emergencies

Student needs to rest or becomes light-headed during treatment	<i>Too rapid breathing, as well as some medications, may cause dizziness. Discontinue treatment. Turn off unit. Continue treatment when student is feeling better.</i>
Student becomes jittery or shaky during bronchodilator treatment	<i>Some medications may cause increased heart rate. See student-specific guidelines.</i>

General Information Sheet

Students Who Need Nebulizer Treatments

Dear (teacher, lunch aide, bus driver):

_____ [Student's name] has a condition that requires nebulizer treatments. Nebulizer treatments deliver medication in mist form directly into the lungs. Nebulizer treatments are also used to give antibiotics and other medications.

A student needing nebulizer treatments will have the necessary equipment in school at all times.

Most students who need nebulizer treatments are able to participate in school activities. A team including the students, parents, and educational and health personnel will help develop a specific health care plan.

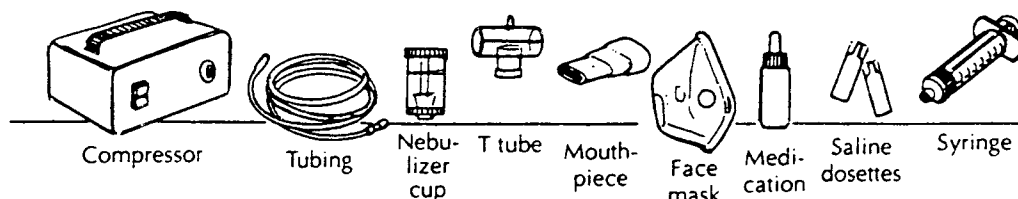
The following staff members have been trained to deal with any problems that may arise with this student:

For more information about nebulizer treatments or the student's needs, consult the school nurse or family.

PROCEDURE FOR AEROSOL TREATMENT BY NEBULIZER WITH AIR COMPRESSOR

PROCEDURE

1. Determine need for treatment based on specific physician's or nurse practitioner's order. The student may ask for treatment.
2. Wash hands.
3. Assemble equipment:



- Compressor/gas cylinder
- Connecting tubing
- Nebulizer cup
- Mouthpiece or mask, T adaptor
- Medication
- Diluting solution
- Saline dosettes
- Syringe
- Filter disc/exhalation filter, if needed

4. Place the unit on a firm, flat surface.
5. Attach the end of the nebulizer tubing to the compressor's air outlet. Unscrew the top from the nebulizer cup.
6. Place the prescribed amount of medicine and diluent into the nebulizer cup.
7. Reattach the nebulizer cap tightly.
8. Attach the connecting tubing to the nebulizer cup outlet.
9. Have the student sit in a comfortable position.
10. Turn on power switch.

POINTS TO REMEMBER

Assess student's status: respiratory rate, depth, effort, pulse, restlessness, color, retractions, cough, and wheezing.

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.

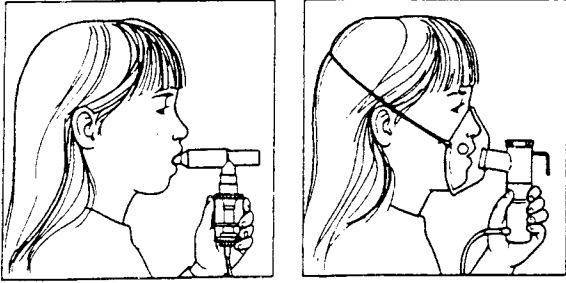
*Some compressors are electrically powered.
Others are battery operated.*

Some medications do not require diluent solution.

Encourage student to participate in the procedure. Assess student's pulse and respiratory rate.

A fine mist should be visible.

11. Have student place mouthpiece in mouth between teeth and seal lips around mouthpiece or place mask over nose and mouth (or tracheostomy).



If a student is able to use mouthpiece for treatment, he or she should be encouraged to take slow, deep breaths during entire treatment.

Note: This illustration does not apply to students receiving medications that need a filter in exhalation port or tightly fitting mask during treatment.

12. Have student begin to breathe in through the mouthpiece or mask.
13. Every 1–2 minutes have student take a deep breath, hold breath briefly, then exhale slowly and resume normal breathing.
14. At the end of treatment turn off power switch.
15. Remove mouthpiece or mask.
16. If ordered, have student take several deep breaths, and cough up secretions.
17. Assess student's respiratory status.
18. Disassemble equipment.
19. Refer to cleaning instructions.
20. Wash hands.
21. Document treatment.
22. Cleaning and care of equipment: After every use, rinse nebulizer assembly, mouthpiece, and mask under warm running water for 30 seconds. Shake off excess water. Lay on clean cloths to dry. Cover with cloth or paper towel. When parts are dry, store them in a clean plastic bag. Follow manufacturer's instructions regarding replacement of filter. Do not wash tubing. Once or twice a week: Clean nebulizer parts more thoroughly. Soak parts in solution of 1 cup white vinegar and 2 cups warm water for 30 minutes. Rinse thoroughly after soaking. Alternatively, parts may be sterilized by boiling or may be cleaned in dishwasher. See product instructions accompanying the unit. ²

Have student breathe at a normal rate and depth. Observe the expansion of the student's chest.

Deep breaths ensure that the medicine is being delivered to the lower airways, not just the mouth. A treatment may last 10–15 minutes. Give student time to rest during procedure if needed. If mist stops and medicine can be seen on sides of cup, tap side of cup, and the mist should start again. Allow all medicine to aerosolize.

If student still is having difficulty breathing or is wheezing, follow student-specific plan.

Report to family any changes in the student's usual pattern of tolerating the procedure. May be done at home. Cleaning the equipment prevents clogging and malfunction and reduces infection. Student-specific nebulizer cup, tubing, and mouthpiece can be reused after cleaning. Compressors can be used for multiple students.

Student's name: _____

Person trained: _____

Position: _____

Nebulizer Treatment Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is to be done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Compressor (or gas cylinder)							
2. Connecting tubing							
3. Nebulizer unit							
4. Mask or T-adaptor and mouthpiece							
5. Medication							
6. Diluent solution							
7. Syringe							
8. Outlet							
9. Inlet							
10. Power switch							
11. Filter disc/exhalation filter, if indicated							
D. Procedure:							
1. Washes hands							
2. Assembles supplies							
3. Positions student and explains procedure							
4. Attaches end of nebulizer tubing to compressor air outlet							
5. Unscrews top from nebulizer cup							
6. Measures medications accurately, draws up medication in syringe or graduated dropper, and injects medication into nebulizer cup							
7. Adds prescribed amount of diluent to nebulizer cup							
8. Reattaches nebulizer cup							
9. Attaches connecting tubing to nebulizer cup							
10. Assesses student:							
a. Takes pulse before starting treatment							
b. Checks respiratory rate and effort							
11. Turns on power switch							

3

(continued)

Format adapted from Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program. (1987). *Getting it started and keeping it going: A guide for respiratory home care of the ventilator assisted individual*. New Orleans, LA: Author; adapted by permission.
Children and Youth Assisted by Medical Technology in Educational Settings (2nd ed.) © 1997 Paul H. Brookes Publishing Co., Baltimore.

Nebulizer Treatment Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
12. Checks mist production and starts treatment and assesses student after 5 minutes							
13. Places mouthpiece in mouth or mask over face/tracheostomy							
14. Allows medication to aerosolize before ending treatment							
15. Asks student to cough and suction if needed							
16. At end of treatment turns off power switch							
17. Assesses student's status after treatment							
18. Describes proper cleaning method for equipment and stores properly							
19. States frequency for replacement of equipment and supplies							
20. States steps for replacing filter							
21. Washes hands							
22. Documents treatment							
23. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

Postural Drainage and Percussion

Special Considerations

Caution: Postural drainage and percussion should never be performed without a suction machine immediately available. Many students cannot cough and expectorate effectively on their own; therefore, performing postural drainage without a suction machine is hazardous. Other considerations are:

1. Performance of this procedure during school hours is rarely necessary.
2. The length of time needed to perform this procedure may prevent the student from participating in educational activities.
3. The procedure is complex and if properly taught to unlicensed school staff will require a considerable amount of time.
4. Performance of this procedure by a person without highly developed skills is at best ineffective and at worst injurious to the student.
5. Never to be performed immediately after a meal.

I. Purpose

The purpose of postural drainage is to maintain maximum lung capacity by assisting students who have difficulty raising sputum.

Students needing postural drainage have pulmonary dysfunction, such as cystic fibrosis, chronic bronchitis, asthma, and other pulmonary disorders, muscular dystrophy, cerebral palsy, and so forth. Postural drainage may be performed two to four times daily depending on the student's tolerance and the physician's orders. Additional postural drainage may be indicated when the student is congested or is having respiratory distress.

This procedure requires a physician's authorization. The service must be re-authorized yearly by the prescribing physician and the lawful custodian. Physicians usually modify and abbreviate this procedure. As a result, it then may be provided during the school day.

II. Suggested Settings

In the rare instances when it may be necessary to provide postural drainage at school, a clean, private environment is necessary. The school health room is recommended and is should be equipped with a bed that can be elevated and lowered and two pillows must be available in order to properly perform the procedure.

III. Special Equipment

A suction machine should always be immediately available (also see procedure for suctioning). A stethoscope for auscultation of lung sounds is important and an ample supply of tissues with a plastic lined receptacle for used tissues are essential for this procedure.

IV. Suggested Personnel and Training

A health care assessment needs to be completed by the school nurse. State nurse practice regulations must be consulted for guidance on delegating health care procedures.

School personnel with regular contact with the student who requires postural drainage should receive general training, covering the student's specific health care needs and potential problems, as well as how to obtain assistance if problems occur.

The basic skills checklist included at the end of this procedure can be used as a foundation for competency-based training in appropriate techniques. It outlines specific procedures step-by-step that are to be performed by the registered nurse. Once the procedures have been mastered by the nurse, the completed checklist serves as documentation of training that has been provided by the student's physician or other health professional.

V. Individualized Health Care Plan

Each students' Individualized Health Care Plan must be tailored to his/her needs. A sample of the Individualized Health Care Plan and Anticipated Health Crisis Plan are found in Appendix A. These may be copied and used to develop a plan for each student. The following sections cover procedures for use of an inhaler. It is essential that the procedure be reviewed before writing the Individualized Health Care Plan.

For a student who requires postural drainage, the following items should receive particular attention:

- Student's baseline status
- Appearance and consistency of secretions
- Aeration of all lobes of lungs before the procedure is started and on completion of procedure.
- Assessment of student's overall appearance before, during and after procedure
- Documentation of use of suction equipment with amount of exudate measured if possible
- History of use of steroids and awareness of potential for rib fractures if procedure is not carefully and correctly performed
- Careful positioning
- Latex allergy alert
- Universal precautions

Postural Drainage and Percussion

Procedure

1. Assemble the equipment in an appropriate location.
2. Use the following sequence for percussing each lobe of the lungs:
 - a. Place the student in an appropriate position.
 - b. Percuss the lobes for 3 minutes over the appropriate area.
 - c. Instruct the student to cough into tissue following each percussion. Discard used tissues into a lined wastebasket. Use vibration (applying pressure to the appropriate lobe during coughing).
 - d. Do oro-pharyngeal suctioning if the student is unable to clear secretions by coughing.
3. The ten positions for percussing students weighing 40 pounds(18 kg) or more are as follows:

Number 1. Position the student on stomach with right side of torso and right arm elevated on pillow.

Points to Remember

Ten positions are necessary for percussing all lobes of the lungs. Use cupped hands with moderate pressure to create a hollow sound during percussion. avoid percussing over the kidneys.

Initial coughing attempts may not produce sputum. When further positioning and percussion are provided, coughing will become productive. (Use of vibration may break bones when students have abnormal bone conditions or are receiving medication, such as steroids.)

Refer to "Suctioning, Nasal and Oral" on pp's 26-28.

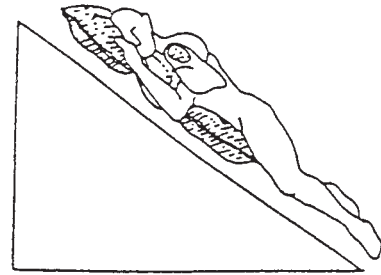
See step 4 in this procedure for techniques for percussing students under 40 pounds (18kg.)



Position 1. This one-quarter turn of the body is the correct position for percussing the posterior segment of the right upper lobe-over the right upper scapular area.

Note: In all positioning, additional pillows may be necessary to obtain the desired elevation; the need for additional pillows depends on the student's weight.

- Number 2.* Position the student on stomach with left side of torso and left arm elevated on pillow.



Position 2.

This one-quarter turn with head and shoulder elevation is the correct position for percussing the posterior segment of the left scapular area. The left bronchus is more vertical, thus requiring a nearly 45 degree elevation.

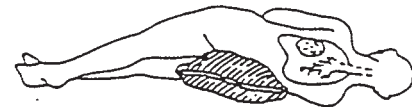
- Number 3.* Position the student flat on back, with pillows placed under the head and knees.



Position 3.

This position is correct for percussing anterior segments of right and left upper lobes-between the clavicle and nipple areas.

- Number 4.* Position the student on back. Turn hips one-quarter turn to the right. Elevate hips 10 to 12 inches with pillows. Use additional pillows, as needed to hold hips to the right.



Position 4.

This position is correct for percussing the lingular process (left lower part) of left lung-from left armpit to nipple area.

- Number 5.* Position the student on back. Turn hips one-quarter turn to the left. Elevate hips 10 to 12 inches with pillows. Use additional pillows as needed to hold the hips to the left.



Position 5.

This position is correct for percussing the middle lobe of the right lung-from the right armpit to nipple area.

Number 6. Position the student flat on stomach with pillows under the stomach and lower legs and feet.



Position 6.

This position is correct for percussing apical (top) segments of the right and left lower lobes-over the lower scapular areas.

Number 7. Position the student on back-elevate hips 16 to 18 inches with pillows.



Position 7.

This position is correct for percussing anterior basal segment of right and left lower lobes-over lower chest area below nipples.

Number 8. Position student on stomach. Elevate hips 16 to 18 inches with pillows.



Position 8.

This position is correct for percussing posterior basal segments of right and left lower lobes-over lower chest areas (avoid kidneys).

Number 9. Position student on right side. Elevate hips to 16 to 18 inches with pillows.



Position 9.

This position is correct for percussing lateral basal segment of left lower lobe-over left side from beneath armpit to end of rib cage.

Number 10. Position student on left side. Elevate hips 16 to 18 inches with pillows.



Position 10.

This position is correct for percussing lateral basal segment of right lower lobe-over right side from beneath armpit to end of the rib cage.

4. The techniques for percussing students under 40 pounds (18kg) and other students in a sitting position are as follows:

Number 1. Person who does the percussing sits in chair with legs outstretched at a 45 degree angle and with bottom of feet braced against solid upright object.

Place pillow in front of your knees. Place the student face down on your lap with his or her chin resting on the pillow.

Number 2. Seated as before, hold student face up on your lap, with his or her head resting on pillow.

This position is correct for percussing posterior basal segments of lower lobes-over area from lower scapula to end of rib cage.

Note: Preschool students and infants usually have no upper lobe involvement requiring percussion. Percuss with light pressure.

This position is correct for percussing anterior segments of lower lobes-over area from below nipple to end of rib cage.

Note: For babies, be sure that head is firmly supported in both positions and percuss with light pressure.

5. After the student has percussed and coughed in all ten positions, assist him or her with five breathing techniques.
- Percussion assists the student in raising sputum from the lung. This time is the best for maximum aeration of the lungs.*
- Number 1.* Encourage diaphragmatic breathing (breathing with the diaphragm instead of the chest). Repeat about 15 times.
- Check for correct breathing by holding hand at upper abdomen and feeling it rise and fall while the chest is still. Encourage diaphragmatic breathing at all times.*
- Number 2.* Have student raise arms over head while breathing in and lower arms while breathing out. Repeat about 15 times.
- Maintain breathing pattern while performing this exercise. Encourage this type of breathing in functional activities, such as combing hair, lifting, and so forth.*
- Number 3.* Have student extend arms outward while breathing in and put arms across the chest while breathing out. Repeat about 15 times.
- Maintain breathing pattern while performing this exercise. Encourage slow expiration.*
- Number 4.* Encourage student to use prolonged expiration; e.g., pursed-lip breathing. Repeat several times.
- This technique assists student in emptying the lungs.*

Number 5. Assist student in progressive relaxation, using several techniques:

This procedure assists students to minimize asthmatic attacks or other respiratory distress symptoms. Progressive relaxation is used along with the physician's recommendations.

- a. Imagery: Think of pleasant thoughts such as being at the beach, breathing fresh air, and so forth.
 - b. Autogenic phrasing: Feel hands getting warm and heavy to promote relaxation, and so forth.
 - c. Progressive muscular relaxation: Contract right arm, relax right arm, repeat for left arm, and so on.
6. At the end of each day, close and secure the liner from the wastebasket tightly before disposing of the contents.
 7. Document procedure on the student log.

Postural Drainage and Percussion Skills Checklist

Student's Name: _____

Person Trained: _____

Position: _____

Instructor: _____

	Demo	Return Demonstration					
	Date	Date	Date	Date	Date	Date	Date
A. States name and purpose							
B. Identifies Supplies							
1. Suction machine							
2. Stethoscope							
3. Tissues							
4. Lined waste receptacle							
5. Appropriate recliner							
6. Two pillows							
C. Steps							
1. Identifies 10 positions for percussion							
2. Assembles supplies							
3. Washes hands							
4. Prepares suction equipment							
5. Positions student correctly in all 10 positions							
6. Percusses lobes							
7. Instructs student to cough into tissue							
8. Describes exudate, discards in lined container							
9. Performs suctioning and measures exudate if student unable to cough							
10. Discusses weight requirements for reclining position drainage							
11. Demonstrates sitting percussing drainage technique							
12. Demonstrates the five breathing techniques Diaphragmatic breathing Raised and lowered arms Arms outward, then folded on chest Prolonged expiration Progressive relaxation							
13. Properly disposes of respiratory exudate							
14. Documents procedure							

4

Checklist content reviewed by:

Parent/Lawful Custodian

Date

NOSE AND MOUTH SUCTIONING

PURPOSE

Nasal and/or oral suctioning are performed when the student needs assistance in clearing secretions from the airway. Indications of this include the following:

- Noisy, rattling, or gurgling breathing sounds
- Secretions (e.g., mucus or saliva) pooling in the back of the throat
- Respiratory distress (e.g., difficulty breathing, agitation, paleness, excessive coughing or choking, cyanosis [blueness])

The student may request suctioning and may be able to assist with the procedure.

SUGGESTED SETTINGS

Routine, nonemergency suctioning can be done in a clean, private area outside of the classroom, such as the health room or a corner of the classroom. Suctioning can be a noisy procedure and may be distracting and disruptive to the rest of the class.

If a suction machine that requires electricity is used, the setting must have an accessible electric outlet. All students who require routine suctioning must have a portable suction machine and suctioning equipment to accompany them in transport.

SUGGESTED PERSONNEL AND TRAINING

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

Nose and mouth suctioning should be performed by a caregiver with proven competency-based training in appropriate techniques and problem management. All school personnel who have regular contact with a student who requires nose and mouth suctioning must receive general training that covers the student's special health care needs, potential problems, and how to implement the established emergency plan.

The basic skills checklist on pp. 28-29 can be used as a foundation for competency-based training in appropriate techniques. It outlines specific procedures step by step. Once the procedures have been mastered, the completed checklist serves as a documentation of training.

THE INDIVIDUALIZED HEALTH CARE PLAN: ISSUES FOR SPECIAL CONSIDERATION

Each student's individualized health care plan (IHCP) must be tailored to the individual's needs. The following section covers the procedures for nose and mouth suctioning as well as possible problems and emergencies that may arise. It is essential that this section be reviewed before writing the IHCP.

A sample plan is included in this manual. It may be copied and used to develop a plan for each student. For a student who needs nose and mouth suctioning, the following items should receive particular attention:

- Student's underlying condition and the possible complications arising from the condition or treatment
- Student's baseline status (e.g., color, respiratory rate, pulse, usual amount of secretions, frequency of suctioning)
- Signs and symptoms of respiratory distress (e.g., agitation, cyanosis, noisy breathing)
- Ability of the student to request assistance
- Usual indications for suctioning
- Latex allergy alert
- Universal precautions (Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.)

Possible Problems with Nose and Mouth Suctioning that Require Immediate Attention

Observations

Student develops a nosebleed during suctioning

Reason/Action

Stop suctioning. Gently squeeze bridge of nose with your fingers and hold for 5 minutes. Once bleeding has stopped, do not use that side of the nose to suction until permission is given by the family or physician.

Student gags or vomits during suctioning

Catheter is probably down too far. Pull back a short distance and complete suctioning. If vomiting occurs, stop suctioning and remove catheter. Position student to keep airway open. Wait until vomiting has stopped. Make sure that the student is able to breathe easily. After vomiting, the student may require repeat suctioning. Be careful that catheter is not down too far.

General Information Sheet

Students Who Need Suctioning

Dear (teacher, lunch aide, bus driver):

_____ [Student's name] has a condition that requires suctioning. Suctioning helps the student breathe better by clearing secretions/mucus from the airway. Depending on the student's age, he or she may be able to request suctioning when needed or assist in the procedure.

A student needing suctioning will have the necessary equipment at all times.

Most students who need suctioning are able to participate in school activities. A team including the students, parents, and educational and health personnel will help develop a specific health care plan.

The following staff members have been trained to deal with any problems that may arise with this student:

For more information about suctioning or the student's needs, consult the school nurse or family.

PROCEDURE FOR NOSE AND MOUTH SUCTIONING WITH A BULB SYRINGE

PROCEDURE

1. Wash hands.
2. Assemble equipment:
 - Bulb syringe
 - Saline
 - Tissues
 - Gloves
3. Wash hands.
4. Explain the procedure to the student, according to his or her level of understanding.
5. Position student.
6. Put on gloves.
7. Squeeze the bulb syringe away from student and place the tip gently into the nose or mouth, where secretions are visible or audible, and let the bulb fill up.
8. Remove the bulb syringe from the nose or mouth.
9. Holding the syringe over a tissue or basin, squeeze the bulb to push out the secretions, then let it fill with air.
10. Repeat Steps 7–9 as needed until nose and mouth are clear.
11. If the nose secretions are too thick, put a few drops of saline in each nostril before suctioning with bulb syringe.
12. Clean bulb syringe in hot soapy water, rinse with fresh water, let dry, and store.
13. Dispose of tissues in appropriate receptacle.
14. Remove gloves.
15. Wash hands.
16. Note color, consistency, and amount of secretions on student's log sheet.

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.

Always suction nose first.

Position varies. See student-specific guidelines.

When suctioning the mouth, suction under the tongue, in the cheeks, and in the back of the throat. Be careful when suctioning the back of the throat, as this may cause the student to gag and vomit.

Report to the family any changes from the student's usual pattern. 5

Suctioning—Nose and Mouth with Bulb Syringe Skills Checklist

Student's name: _____

Person trained: _____

Position: _____

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Bulb syringe							
2. Saline							
3. Tissues							
4. Gloves							
D. Procedure:							
1. Washes hands							
2. Assembles supplies							
3. Positions student and explains procedure							
4. Washes hands and puts on gloves							
5. Squeezes bulb syringe, places tip gently in nose or mouth, and releases (Always suction nose before mouth.)							
6. Remove bulb syringe from nose or mouth							
7. Squeezes and releases bulb into tissue, expelling secretions (repeats Steps 5–7 until secretions are removed)							
8. Cleans bulb syringes, disposes of tissues							
9. Removes gloves and washes hands							
10. Documents procedure and observations							
11. Reports any changes to family							

6

Checklist content approved by: _____

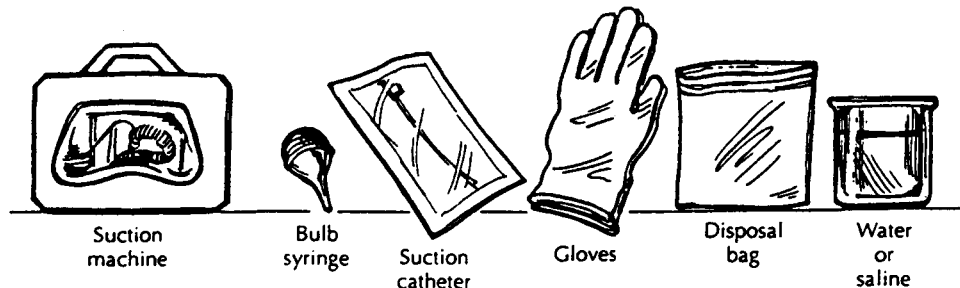
Parent/Guardian signature _____ Date _____

Format adapted from Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program. (1987). *Getting it started and keeping it going: A guide for respiratory home care of the ventilator assisted individual*. New Orleans, LA: Author; adapted by permission.
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PROCEDURE FOR NOSE AND MOUTH SUCTIONING USING SUCTION MACHINE

PROCEDURE

1. Wash hands.
2. Assemble the equipment:



- Suction machine (battery operated or plug-in) and tubing
- Bulb syringe or other manual backup
- Suction catheter of the appropriate size
- Disposable gloves
- Plastic bag for disposal of materials
- Water or saline to clean catheter, with container

3. Position student. Explain the procedure to the student, according to his or her level of understanding. If able, the student should assist.
4. Turn on suction machine to check function.
5. Encourage the student to cough to expel secretions.
6. Open suction catheter or kit without touching the inside of package.
7. Put on gloves.
8. In the dominant hand, hold the catheter and attach appropriate end to the suction machine. Keep the other end of the catheter in the package.

9. Turn on machine with other hand to prescribed suction pressure.
10. Hold suction catheter 2–3 inches from the tip with dominant hand.

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.

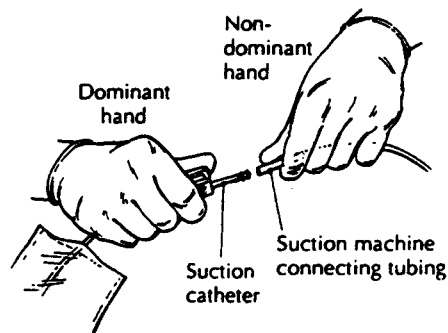
All equipment for suctioning must be assembled and ready for immediate use at all times. It must be checked daily by designated personnel.

This cleans and lubricates the catheter.

Position may vary and should be recommended in student-specific guidelines. By encouraging the student to assist in the procedure, the caregiver is helping the student achieve maximum self-care skills.

This may eliminate the need for suctioning or may bring secretions up for easier suctioning. This keeps catheter clean and reduces risk of transmitting infection.

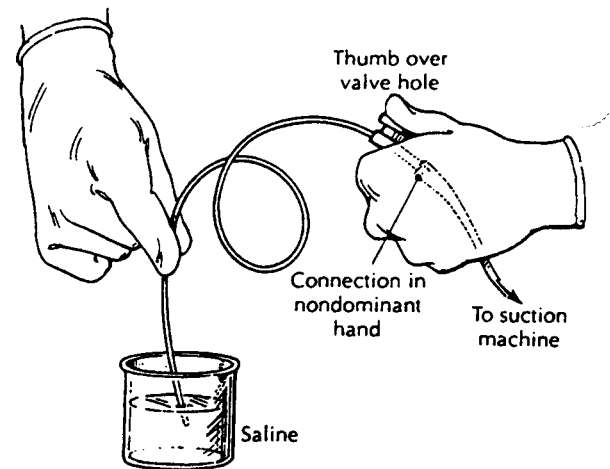
Dominant hand, which is used to manipulate catheter, should remain clean.



Portable machines may not have adjustable pressure settings.

11. Grasp catheter connection with other hand; cover vent hole with thumb to suction a small amount of water through the catheter.
12. Remove covering from end of suction catheter with nondominant hand while holding catheter in dominant hand.
13. With thumb off vent hole, insert catheter gently into the nose to the prescribed depth suggested in student-specific guidelines.
14. Cover vent hole with nondominant thumb while suctioning and withdrawing catheter. Gently rotate catheter between thumb and index finger while suctioning and withdrawing.
15. Suction up some water to rinse secretions out of catheter.
16. If nasal congestion persists, repeat nasal suction.
17. With thumb off vent hole, insert catheter gently into the mouth.
18. Cover vent hole with nondominant thumb. Gently rotate catheter between thumb and index finger while suctioning and withdrawing.
19. Suction up some water to rinse secretions out of catheter.
20. If gurgling noises persist, repeat mouth suctioning procedure with the same catheter.
21. Discard catheter.
22. Discard gloves in an appropriate receptacle.
23. Wash hands.
24. Note color, consistency, and amount of secretions on daily procedure log sheet.

This tests that suction machine is working and lubricates the catheter.



Always suction the nose first. There are more bacteria in the mouth. Many students may only need to have the anterior part of the nose suctioned. Be gentle; the nose bleeds easily. Make sure catheter tip has been lubricated with saline or water-soluble lubricant. If the nose secretions are too thick, put a few drops of saline in each nostril.

Rotating the suction catheter diminishes damage to the mucus membrane. If the catheter sticks, remove thumb from vent hole to release suction.

Parts of the mouth to be suctioned include the back of the throat, the cheeks, and under the tongue. Be careful when suctioning the back of the throat, as this may cause the student to gag and vomit.

This helps to minimize trauma to the membranes of the mouth.

If, after suctioning of the mouth, repeat suctioning of the nose is needed, use a clean catheter.

Report to the family any changes from the student's usual pattern.

Student's name: _____

Person trained: _____

Position: _____

Suctioning—Nose and Mouth Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Suction machine with tubing							
2. Catheter							
3. Cup of tap water or saline							
4. Bulb syringe							
5. Gloves							
6. Plastic bag for disposal							
D. Procedure:							
1. Washes hands							
2. Assembles supplies							
3. Positions student and explains procedure							
4. Washes hands							
5. Turns on suction machine and checks functions							
6. Removes catheter from storage bag being careful not to touch the last 5 inches of catheter, puts on gloves							
7. Attaches catheter to suction tubing							
8. Inserts catheter into nose and advances until student coughs without suction (if resistance occurs, do not proceed with catheter. Nasal area bleeds easily.)							
9. Applies suction when student coughs and withdraws catheter while twirling catheter							
10. Puts a few drops of normal saline into nose to thin secretions (if they are thick)							
11. Repeats suctioning in this order (Steps 8–10) until nose is clear							
12. Suctions mouth by advancing catheter into mouth without suction							
13. Applies suction and withdraws catheter while twirling							

Format adapted from Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program. (1987). *Getting it started and keeping it going: A guide for respiratory home care of the ventilator assisted individual*. New Orleans, LA: Author; adapted by permission.

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Suctioning—Nose and Mouth Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Da
14. Repeats suctioning in above order (Steps 12–13) until mouth is clear							
15. Does not suction nose again after suctioning mouth. Disposes of catheter							
16. Rinses tubing with tap water							
17. Removes gloves and washes hands							
18. Documents procedure and observations							
19. Reports any changes to family							

Checklist content approved by:

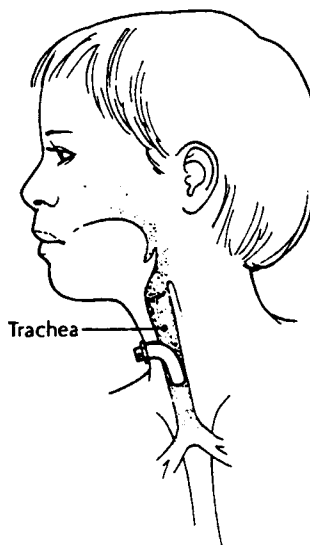
Parent/Guardian signature _____ Date _____

TRACHEOSTOMY

PURPOSE

A tracheostomy is a surgical opening in the neck into the trachea (windpipe), which allows air to go in and out of the lungs. The opening in the neck is called a stoma. A metal or plastic tube, called a tracheostomy tube, may be inserted through the stoma into the trachea; some students may not need a tracheostomy tube. There are various types of tracheostomy tubes that are held in place with a tie around the neck.

Some students will have a tracheostomy because of an injury or condition that requires bypassing the normal breathing passages. Others require a tracheostomy because of neurological, muscular, or other conditions that make it difficult for them to breathe effectively or to clear secretions or mucus out of their breathing passages without assistance. A tracheostomy allows long-term access to a ventilator or respirator (i.e., breathing machine) and an easy way to clear the trachea of mucus. Many students with tracheostomies are able to speak. Most are able to eat and drink by mouth but may need dietary modifications.



SUGGESTED SETTINGS

Students with tracheostomies, in most cases, can attend classes in general classrooms. Some may need to be accompanied by a trained caregiver at all times in the educational setting or during transport. Many students with tracheostomies participate in school activities with modifications that should be determined by the family, physician, school nurse, and school staff. **All staff in contact with students with tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the emergency plan for their setting.**

Students with tracheostomies should avoid areas with a lot of dust or other airborne particles, such as chalk dust. Such areas should be avoided because the air the student breathes enters the lungs directly without being filtered, humidified, and warmed by the nose and mouth.

Regular tracheostomy care prescribed to maintain the student's health and function should be done at home. If additional regular care is required, however, it should be done in a private, clean area, such as the health room. In an emergency, care should be given wherever the student is. Therefore, it is imperative that a complete set of equipment for tracheostomy care, including all items in the go-bag (p. 355) and suction machine be with the student at all times.

SUGGESTED PERSONNEL AND TRAINING

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

Tracheal care for students who require care in school, such as suctioning, saline instillation, use of a tracheostomy collar, or other daily care, should be provided by a registered nurse or licensed respiratory therapist unless state medical and nursing practice standards specify otherwise. These caregivers should have proven, competency-based training in appropriate techniques and problem management. **All staff in contact with students with tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the emergency plan for their setting.**

www.kdhe.state.ks.us/c-f/special_needs_part2.html

There are different service delivery models available for tracheostomy care that involve nonmedical personnel. The recommendations herein are conservative and are based on the following issues:

- The lack of standardization in nursing and medical practice
- The highly technical nature and potential risk to the student

Under some circumstances, after a student with a tracheostomy has been in the school setting for a period of time and it is clear that the student's medical condition is stable, it may be appropriate for the health care team and the family to consider using a nonmedical caregiver who has received appropriate training and supervision by a school nurse who is in the building at all times.

Some students need less frequent care or require no routine tracheostomy care at all. The decision regarding the placement of the caregiver for such a student must be made by the family, physician, and school nurse and be based on the student's medical condition, tracheal care needs, and adaptation to school. Other considerations should include the varied locations of the student in the school, the school nurse-to-pupil ratio, and a school nurse being in the building at all times.

If the trained caregiver and back-up personnel are unable to be available on a given school day, the student should not attend school. However, an optional arrangement could be made between the school and the family so someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student with a tracheostomy must receive general training that covers the student's specific health care needs, potential problems, and how to implement the established emergency plan.

The basic skills checklists on pages pp. 54-62 can be used as a foundation for competency-based training in appropriate techniques and problem management. They outline specific procedures step by step. Once the procedures have been mastered, the completed checklists serve as a documentation of training.

THE INDIVIDUALIZED HEALTH CARE PLAN: ISSUES FOR SPECIAL CONSIDERATION

Each student's individualized health care plan (IHCP) must be tailored to the individual's needs. The following sections cover the procedures for tracheostomy care and possible problems and emergencies that may arise. It is essential that these sections be reviewed before writing the IHCP.

A sample plan is included in this manual. It may be copied and used to develop a plan for each student. For a student who requires tracheal care, the following items should receive particular attention:

- Student's underlying condition and possible problems associated with the condition or treatment
- Student's baseline status (e.g., color, respiratory rate, pulse, blood pressure, secretions)
- Student's care requirements (e.g., suctioning)
- Student's ability to request assistance
- Student's proneness to emergencies
- Signs and symptoms of respiratory distress shown by this student
- Type of tracheostomy tube used (e.g., inner cannula, cuffed)
- Accessibility to equipment and back-up equipment
- An alternate means of warming and moisturizing the air may be necessary at times to prevent the mucus from becoming too thick
- Student's need for additional fluids
- Student's speech may be affected—alternative means of communication may be necessary (i.e., American Sign Language, Passey-Muir valve, communication board)
- Personnel and equipment needed for transportation (e.g., travel bag)
- Availability of caregivers

www.kdhe.state.ks.us/c-f/special_needs_part2.html

- Staffing needs to provide care for the student (one to one)
- Means of communication (e.g., walkie-talkies, intercoms, telephones) among different areas of the school
- Latex allergy alert
- Universal precautions (Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.)

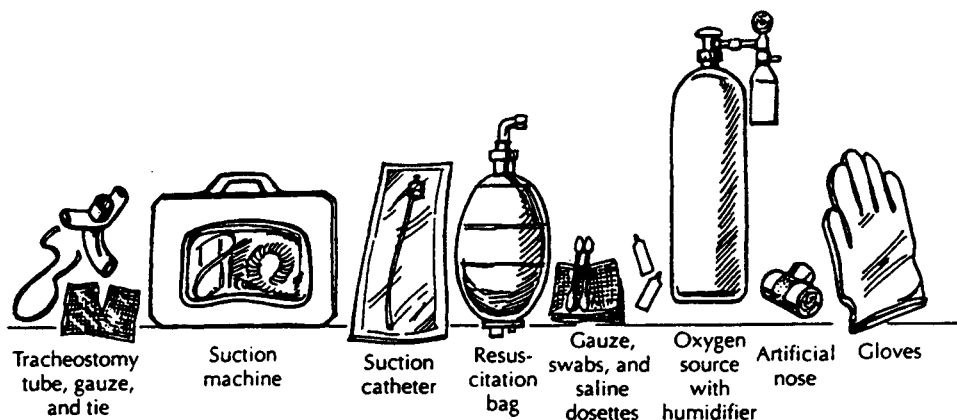
Do not use powders; aerosols (i.e., room deodorizers); small particles, such as sand, glitter, lint, chalk dust, and animal hair; small pieces of food and water; or glue or chemicals with strong fumes near a student with a tracheostomy. Students who may have accidental contact with any of these potential hazards should have some kind of protective covering for the tracheostomy.

REQUIRED EQUIPMENT FOR TRACHEOSTOMY CARE

REQUIRED EQUIPMENT

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.



- Spare tracheostomy tube and obturator with gauze pads and ties or Velcro collar
- Scissors
- Suction machine
- Equipment for suctioning (e.g., suction catheters)
- Sterile or clean gauze, cotton-tip swabs, if required
- Pipe cleaners
- Saline dosettes if prescribed
- Manual resuscitator with adaptor
- One half hydrogen peroxide and one half normal saline or one half distilled water
- Device to deliver humidity, if prescribed
- Device to deliver oxygen, if prescribed
- Device, such as an artificial nose, for protecting tracheostomy from dry or cold air and dust or other particles
- Sterile or disposable gloves, per student-specific guidelines
- Manual suction device
- Syringe to inflate or deflate tracheostomy cuff

Not all tracheostomy tubes require obturator use.

This equipment must accompany the student at all times, including transport and classroom activities. A backpack or other carrying device could serve as a travel bag. This equipment should be checked daily.

It is encouraged that a manual resuscitation bag with adaptor be obtained if the student does not have one at home to bring to school.

*The artificial nose must be changed if it appears to be saturated with moisture or secretions. **Do not rinse.** Discard if saturated.*

Refer to universal precautions in Chapter 5.

Back-up suction if battery fails.

Possible Problems that Require Immediate Attention for Students with Tracheostomies

Observations	Reason/Action
<p>DO NOT LEAVE STUDENT ALONE.</p> <p>The student shows any of the following signs of respiratory distress:</p> <ul style="list-style-type: none"> • Coughing • Color changes • Wheezing or noisy breathing • Agitation • Retraction 	<p><i>This may be due to a plugged tracheostomy tube from mucus, aspiration of foreign matter, accidental decannulation, or dislodged tracheostomy tube.</i></p> <p><i>Reassure student. Check air movement from tracheostomy. Check placement of tracheostomy tube. If tracheostomy tube is in place, suction.</i></p>
Tracheostomy tube is dislodged	<p><i>Reposition tracheostomy tube, if possible. If unable to reposition tube, insert new (spare) tracheostomy tube. Check air movement. Give breaths with resuscitation bag, if indicated. Administer oxygen if prescribed in emergency plan, and initiate emergency plan and begin cardiopulmonary resuscitation if necessary. Notify family and physician.</i></p>
Suction catheter will not pass or there is no air movement from tracheostomy	<p><i>Change inner cannula if present or replace tracheostomy tube. Check air movement. Give breaths with resuscitation bag, if necessary. Give oxygen, if prescribed in emergency plan, and initiate emergency plan and begin cardiopulmonary resuscitation if necessary. Notify family and physician.</i></p>
Aspiration of foreign material (e.g., food, sand) into tracheostomy	<p><i>Suction first. Do not give breath with resuscitation bag. This may force aspirate into lungs. Give breaths with resuscitation bag after initial suctioning.</i></p> <p><i>Check air movement.</i></p> <p><i>If tracheostomy tube remains blocked by foreign material, change tracheostomy tube. Check air movement.</i></p> <p><i>Add saline and give breaths with resuscitation bag. Repeat suctioning. Repeat above steps until aspirated secretions are clear or gone.</i></p> <p><i>Give breaths with resuscitation bag if indicated.</i></p> <p><i>Administer oxygen if prescribed in emergency plan.</i></p> <p><i>Bronchospasm (wheezing) may also occur. The student may require medication.</i></p> <p><i>Respiratory distress or arrest can occur with any aspiration. Be prepared to initiate emergency plan. Begin cardiopulmonary resuscitation after suctioning, if needed. Notify family and physician.</i></p>

Potential Problems that Do Not Require Immediate Attention

Observations

Increased secretions or thicker than usual mucus

Fever

Redness or crusting at the stoma

Bleeding or pain at stoma site

Bloody secretions from tracheostomy

Reason/Action

May require more frequent suctioning. These changes, or yellow or green mucus, may indicate infection. This should be documented in the daily log, and the family should be informed. Thicker mucus also may be a sign of insufficient humidity.

May be a sign of respiratory infection. Notify family.

May be due to a tracheal infection. The site should be thoroughly cleaned and the problem documented in the daily log and reported to the family.

May be due to infection or trauma. Notify family.

May be due to infection or trauma from vigorous suctioning. Notify family.

General Information Sheet

Students with Tracheostomies

Dear (teacher, lunch aide, bus driver):

_____ [Student's name] has a condition that requires a tracheostomy. This is an opening in the neck into the windpipe, which allows the student to breathe if he or she is unable to breathe well through the nose or mouth. The opening, or stoma, may have a metal or a plastic tracheostomy tube inside to keep it open and to allow air to pass in and out of the windpipe and lungs. The tube is secured by trach ties that are tied around the student's neck. The student's tracheostomy tube may be covered with a device that provides humidity or oxygen. Some people have nothing covering the opening of the tube.

Most students with tracheostomies are able to eat and drink by mouth. If the student cannot eat or drink, his or her physician will give you specific instructions. Many students are able to speak normally. If the student's condition prevents him or her from speaking, other means of communication will be used. Not all students who have tracheostomies require routine tracheostomy care in school. Many students can manage their care, but some who require regular tracheostomy care such as suctioning, a procedure to remove mucus from the tracheostomy tube, will have a trained caregiver with them.

Most students with tracheostomies are able to participate in school activities. A team including the student's family and educational and health personnel will help develop a specific health care plan. Classroom issues will be addressed in the care plan, such as the accommodation of health care during the school day with minimal interference, the avoidance of activities (e.g., swimming) that could affect the function of the tracheostomy, and avoidance of infectious exposure such as colds.

The following staff members have been trained to deal with any problems that may arise with this student:

It is recommended that you participate in cardiopulmonary resuscitation training and request specialized training for people with tracheostomies.

For more information about this procedure or the student's needs, consult the school nurse or family.

TRACHEAL SUCTIONING

PURPOSE

Tracheal suctioning is a means of clearing the airway of secretions or mucus. This is accomplished by using a vacuum-type device through the tracheostomy. Tracheal suctioning is performed when a person cannot adequately clear secretions on his or her own. Indications for suctioning include the following:

- Noisy, rattling breathing sounds
- Secretions (i.e., mucus) visible and filling opening of tracheostomy
- Signs of respiratory distress (e.g., difficulty breathing, agitation, paleness, excessive coughing, cyanosis [blueness], nasal flaring, retracting)
- No air moving through tracheostomy (listen for sounds)
- Before eating or drinking if congested
- After respiratory treatments (e.g., inhalation therapy, assisted breathing with a self-inflating manual resuscitator), chest percussion, and drainage

Depending on the student's age, he or she may be able to request suctioning when needed or assist with the procedure.

SUGGESTED SETTINGS FOR NONEMERGENCY SUCTIONING

Designate a clean area outside the classroom, if possible, for suctioning. Suctioning can be a noisy procedure and may be distracting and disruptive to the rest of the class.

If an electrically powered suction machine is used, the setting must have an accessible, working, grounded electric outlet.

SUGGESTED PERSONNEL AND TRAINING

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

Tracheal suctioning should be performed by a registered nurse or a licensed respiratory therapist with proven competency-based training in appropriate techniques and problem management, unless state medical and nursing practice standards specify otherwise. **All staff in contact with students with tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the emergency plan for their setting.**

If the trained caregiver and back-up personnel are unable to be available on a given school day, the student should not attend school. However, an optional arrangement may be made between the school and the family so someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student who requires tracheal suctioning must receive general training that covers the student's specific health care needs, potential problems, and how to implement the established emergency plan.

The basic skills checklist on pages 358–359 can be used as a foundation for competency-based training in appropriate techniques. It outlines procedures step by step. Once the procedures have been mastered, the completed checklist serves as documentation of training.

THE INDIVIDUALIZED HEALTH CARE PLAN: ISSUES FOR SPECIAL CONSIDERATION

Each student's individualized health care plan (IHCP) must be tailored to the individual's needs. The following section covers the procedure for tracheal suctioning and possible problems and emergencies that may arise. It is essential that this section be reviewed before writing the IHCP.

A sample plan is included in Chapter 6. It may be copied and used to develop a plan for each student. For a student who requires tracheal suctioning, the following items should receive particular attention:

- Student's underlying condition and possible problems associated with the condition or treatment
- Student's baseline status (e.g., color, respiratory rate, pulse, color and consistency of secretions, usual frequency of suctioning, usual indications for suctioning)
- Student's ability to request suctioning or do it independently
- Availability and use of back-up manual suctioning equipment
- Accessibility of equipment
- Signs and symptoms of respiratory distress shown by the student (e.g., cyanosis, agitation)
- Need for saline instillation
- Need for breaths with a manual resuscitation bag
- Length of tracheostomy tube measured to determine depth of suctioning
- Latex allergy alert (see Chapter 5)
- Universal precautions (Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.)

Possible Problems When Suctioning

Observations

The student develops difficulty breathing during suctioning or is not relieved by suctioning

The tracheostomy tube or inner cannula becomes dislodged

Bleeding occurs during suctioning:

- The secretions become blood-tinged and the student is not in respiratory distress

- A large amount of blood is suctioned from the tracheostomy or the student develops respiratory distress while being suctioned

Bronchospasm occurs during suctioning

Reason/Action

Do not leave student alone. Reassure student.

If tracheostomy tube is blocked (suction catheter will not pass), change inner cannula, if present, or replace entire tracheostomy tube.

Give breaths with resuscitation bag.

Give oxygen.

Reposition using gentle pressure. If unable to reposition tube, insert new tube. Be prepared to initiate emergency plan.

Stop suctioning.

Check vacuum pressure setting. Adjust to lower setting, if appropriate. Continue suctioning as necessary to clear the airway. Use the manual resuscitation bag and oxygen if needed.

Initiate the emergency plan and begin cardiopulmonary resuscitation if necessary.

Reassure student.

May be due to excessive suctioning. Allow student to calm him- or herself. If unable to remove catheter, disconnect from suction tubing and hold oxygen near end of suction catheter. When bronchospasm relaxes, remove catheter. If bronchospasm persists, student may require medication. Notify family and physician.

General Information Sheet

Students Who Need Suctioning

Dear (teacher, lunch aide, bus driver):

_____ [Student's name] has a condition that requires suctioning. Suctioning helps the student breathe better by clearing secretions/mucus from the airway. Depending on the student's age, he or she may be able to request suctioning when needed or assist in the procedure.

A student needing suctioning will have the necessary equipment at all times.

Most students who need suctioning are able to participate in school activities. A team including the students, parents, and educational and health personnel will help develop a specific health care plan.

The following staff members have been trained to deal with any problems that may arise with this student:

For more information about suctioning or the student's needs, consult the school nurse or family.

PROCEDURE FOR TRACHEAL SUCTIONING

PROCEDURE

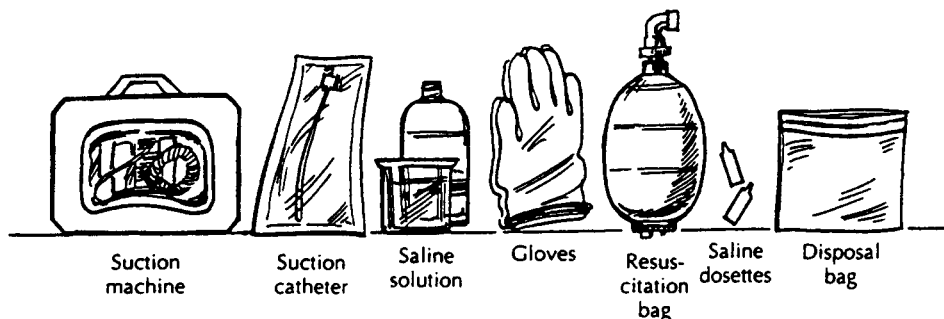
All equipment for suctioning must be assembled and ready for immediate use at all times and checked daily by the trained caregiver. If the equipment is not present or not functional, the student should not attend school.

1. Wash hands.
2. Assemble the equipment and materials on a small, clean work surface:
 - Suctioning machine and manual backup
 - Suction catheter of prescribed size
 - Sterile saline or sterile water to clear catheter
 - Container for saline or water
 - Disposable gloves
 - Self-inflating manual resuscitation bag with tracheostomy adaptor
 - Saline dosettes (for instillation) if indicated
 - Plastic bag for disposal of materials
 - Syringe to inflate and deflate cuff, if used
3. Position student as recommended/ordered.
4. Explain procedure at student's level of understanding.
5. Wash hands.
6. Turn on suction machine and check for function.

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.

A disposable, waterproof underpad may be used.



*All students **must** have a means of suctioning (e.g., a portable suction machine or manual device) that can accompany them during all school activities as well as transport. A manual means of suctioning also must be available as a backup at all times for those students who use suction machines.*

To determine how deep to insert the catheter, it is essential to know the length of the tracheostomy tube. This information is written on the package or may be obtained from the family or primary caregiver.

Refer to universal precautions.

When at school, most students are suctioned while seated upright.

By encouraging the student to assist in the procedure, the caregiver helps the student achieve maximum self-care skills.

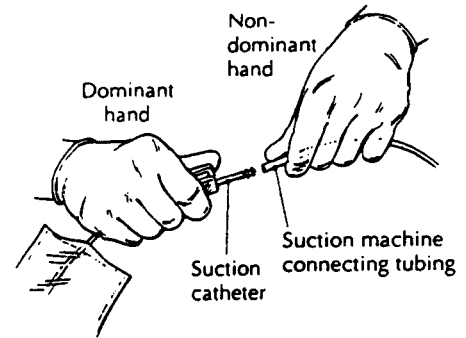
7. Encourage student to cough to expel secretions.
8. Open suction catheter or kit.
9. Open saline dosette if instillation is ordered.
10. Fill container with sterile saline or sterile water.
11. Put on gloves.

12. Holding the end of the suction catheter in dominant hand, attach it to the suction machine tubing (held in other hand).

Coughing may eliminate need for suctioning.

Peel paper back without touching the inside of the package to maintain sterility.

This will be used to moisten the catheter and to clear out secretions in the catheter. The dominant hand should remain "clean." It should not touch anything but the catheter. The nondominant hand should be used to turn on switches or touch other objects. Leave the other end of catheter in its covering.



13. Turn on machine to appropriate vacuum setting (if machine has vacuum setting) for student.
14. Encourage student to cough and to take a deep breath if possible. If prescribed, manually ventilate with resuscitation bag.

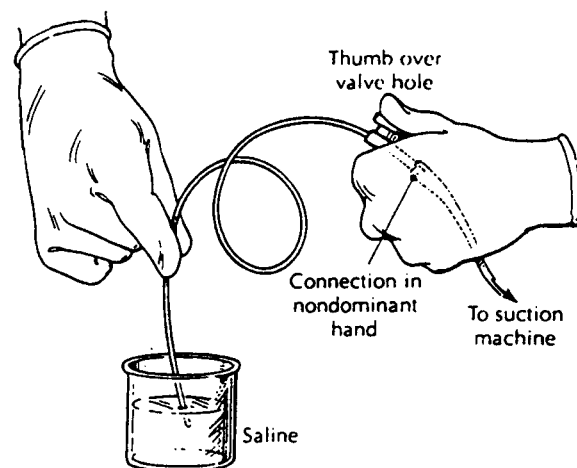
This should be ordered by physician.

Coughing helps to bring secretions up toward the tracheostomy. By taking a deep breath (or manually ventilating), the student will get more oxygen into his or her lungs. This will also help to loosen secretions.



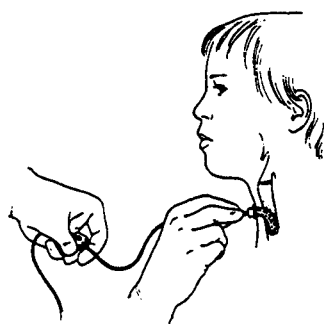
15. Hold suction catheter 2–3 inches from tip with dominant hand and insert tip in sterile saline or sterile water.
16. Grasp catheter connection with other hand; cover vent hole with thumb to suction a small amount of saline through catheter.

This tests that suction is functioning.



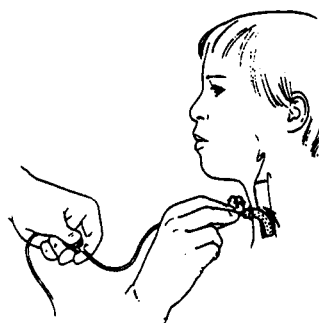
17. With thumb off vent hole, gently and quickly insert catheter into tracheostomy. Do not insert catheter beyond the distal end of the tracheostomy tube.

If the catheter is inserted too deeply, this can cause irritation/injury to the trachea, as well as bronchospasm. Coughing indicates that the suction catheter possibly has passed the end of the tracheostomy tube.



18. Cover vent hole with thumb while withdrawing catheter.

Rotate catheter gently between thumb and index finger while suctioning and withdrawing. This helps to reach all secretions in the tracheostomy tube.



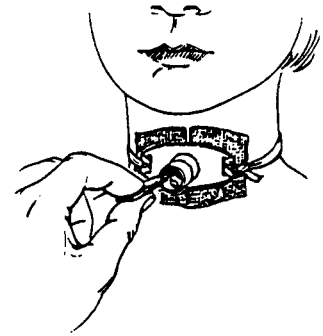
Each insertion and withdrawal of the catheter must be completed within 5–10 seconds. Prolonged suctioning blocks the student's airway and can cause a dangerous drop in the oxygen level.

19. Allow student to breathe or give breaths with resuscitator bag between suctioning passes. Suction saline again through catheter to rinse secretions from catheter and tubing.

The student needs to clear lungs of carbon dioxide and get new oxygen/air into lungs.

20. If prescribed, insert several drops of saline into tracheostomy with nondominant hand. Manually ventilate with resuscitation bag to disperse saline, if ordered.

This helps to loosen and thin out thick or dry secretions.



21. If moist, gurgling noises or whistling sounds are heard or if mucus is seen at the tracheostomy opening, repeat suctioning procedure (Steps 14–20).
22. Suction the nose and then the back of mouth if indicated after completion of tracheal suctioning.
23. For each suctioning session, a new catheter should be used.
24. Disconnect catheter from suction tubing. Wrap catheter around gloved hand. Pull gloves off inside out.
25. Discard used suction catheter in appropriate receptacle. Wash hands.
26. Note color, consistency (e.g., thin, thick), and quantity of secretions.
27. Document procedure on student's log sheet.
28. Be sure suction equipment and supplies are restocked and checked daily and are ready for immediate use.

If appropriate, ask the student if he or she needs repeat suctioning.

If the nose and mouth are suctioned, the catheter cannot be reused to suction the tracheostomy.

Consult family and physician for student-specific use.

Refer to universal precautions . . .

Report any changes from student's usual pattern to family.

Student's name: _____

Person trained: _____

Position: _____

Tracheal Suctioning—Sterile Technique Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Suction machine with tubing							
2. Sterile catheter kit with gloves							
3. Sterile saline							
4. Cup of tap water							
5. Resuscitator bag with tracheostomy adaptor							
6. Gloves (nonsterile)							
D. Procedure:							
1. Washes hands							
2. Assembles supplies							
3. Positions student and explains procedure							
4. Washes hands							
5. Turns on suction machine and checks for function							
6. Opens package and removes kit							
7. Opens kit without touching inside of package, and opens saline and fills container with saline							
8. Removes gloves by holding inside of cuff and pulling gloves over hands that will hold catheter							
9. Picks up catheter and removes catheter							
10. Attaches end of catheter to suction tubing							
11. Uses resuscitator to give three to five breaths, <u>if ordered</u>							
12. Inserts catheter into tracheostomy tube without suction							
13. Advances catheter to end of tracheostomy tube or until student coughs							
14. Applies suction by putting thumb on suction catheter adaptor							

10

(continued)

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Tracheal Suctioning—Sterile Technique Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
15. Twirls catheter between fingers as it is pulled out of tracheostomy tube, leaving in no more than 10 seconds							
16. Gives three to five breaths with resuscitator bag after catheter has been removed from tracheostomy tube							
17. Places drops of saline or prescribed solution in tracheostomy tube (if secretions are thick), follows with extra breaths, then suction							
18. Repeats suctioning in above order (Steps 11–17) until secretions are removed							
19. Suctions nose and mouth with same catheter the same way, if indicated							
20. Completes suctioning, disconnects catheter from suction tubing, wraps catheter around gloved hand, and pulls gloves off inside out; disposes of catheter and gloves appropriately							
21. Rinses suctioning tubing with tap water							
22. Washes hands							
23. Documents procedure and observations							
24. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

Tracheostomy Suctioning— Bulb Technique Skills Checklist

Student's name: _____

Person trained: _____

Position: _____

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Go-Bag supplies (see Go Bag Supplies skills checklist on p. 355)							
D. Procedure:							
1. Washes hands							
2. Assembles supplies							
3. Positions student and explains procedure							
4. Washes hands and puts on gloves							
5. Squeezes bulb syringe; places tip in tracheostomy tube and releases							
6. Removes bulb syringe from tracheostomy tube							
7. Squeezes and releases bulb into tissue, expelling secretions							
8. Repeats Steps 5–7 until secretions are removed							
9. Squeezes bulb syringe for nose/mouth ; places tip in mouth/nose and releases							
10. Removes bulb syringe from nose/mouth							
11. Squeezes and releases bulb into tissue; expelling secretions							
12. Repeats Steps 9–11 until secretions are removed							
13. Cleans bulb syringes and disposes of tissues							
14. Removes gloves, washes hands							
15. Documents procedure and observations							
16. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

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TRACHEOSTOMY TUBE CHANGES

PURPOSE

Tracheostomy tubes are routinely changed to prevent mucus from building up within the tubing. Mucus may block the tube and prevent air from entering the lungs. The tube also may need to be changed if it is blocked or accidentally dislodged. **In a school setting, this procedure should be done only in an emergency situation.**

SUGGESTED SETTINGS

Routine tracheostomy tube changes are performed in the home. This is ideally done when the student has an empty stomach and when the airway is relatively free of mucus. If a tracheostomy tube plugs (becomes blocked) or comes out, the tube should be changed or reinserted wherever the student is, even if conditions are not ideal.

SUGGESTED PERSONNEL AND TRAINING

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

Tracheostomy tube changes should be performed by a registered nurse or a respiratory therapist with proven competency-based training in appropriate techniques and problem management, unless state medical and nursing practice standards specify otherwise. **All staff in contact with students with tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the emergency plan for their setting.**

If the trained caregiver(s) and back-up personnel are unavailable on a given school day, the student should not attend school. However, an optional arrangement may be made between the school and the family so someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student who requires a possible emergency tracheostomy tube change must receive general training that covers the student's specific health care needs, potential problems, and how to implement the established emergency plan.

The basic skills checklist on pages 56-57 can be used as a foundation for competency-based training in appropriate techniques and problem management. It outlines specific procedures step by step. Once the procedures have been mastered, the completed checklist serves as a documentation of training.

THE INDIVIDUALIZED HEALTH CARE PLAN: ISSUES FOR SPECIAL CONSIDERATION

Each student's individualized health care plan (IHCP) must be tailored to the individual's needs. The following section covers the procedure for tracheostomy tube changes as well as possible problems and emergencies that may arise. It is essential that this section be reviewed before writing the IHCP.

A sample plan is included in **this manual**. It may be copied and used to develop a plan for each student. For a student who requires tracheostomy tube changes, the following items should receive particular attention:

- Student's need for support during reinsertion
- Student's underlying condition and possible problems associated with the condition or treatment (e.g., tracheal stenosis)
- Student's baseline status (e.g., color, respiratory rate, pulse)
- Type and size of tracheostomy tube (e.g., inner cannula, cuffed)

- Signs and symptoms of respiratory distress (e.g., cyanosis, agitation)
- Student's ability to request assistance
- Student's ability to breathe without a tracheostomy tube
- Difficulty with reinsertion of a dislodged tracheostomy tube
- Latex allergy alert
- Universal precautions (Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.)

Possible Problems with Tracheostomy Tube Changes that Require Immediate Attention

Observations

The tracheostomy tube comes out:

- Student is not showing signs of distress
- Student shows signs of respiratory distress
- Tube can be inserted and the student is still having difficulty

The tracheostomy tube cannot be reinserted

It is still possible to insert the tracheostomy tube

If insertion of tracheostomy tube is not possible and the student has respiratory distress and/or respiratory arrest

Reason/Action

Never leave student alone. Call for assistance.
Follow procedure for tracheostomy tube change outlined on pages 288–289.

Attempt to insert tracheostomy tube as outlined in procedure.

- Reassure the student.
- Assess airway and breathing.
- Administer oxygen via the tracheostomy.
- Suction the tracheostomy.
- Use bronchodilators, if ordered.
- Use manual resuscitator bag, if indicated.

If distress persists, initiate emergency plan and begin cardiopulmonary resuscitation.

This may be due to a false passage or bronchospasm:

Never leave student alone. Call for assistance.

- Reassure the student.
- Encourage the student to take a deep breath—be prepared to insert tube if stoma opens.
- Administer flow of oxygen directly to the tracheostomy stoma.
- Reposition the student.
- Attempt to insert the smaller tracheostomy tube or thread a suction catheter through the new tracheostomy tube and attempt to insert catheter through stoma into trachea as a guide for tracheostomy tube.
- Slide tracheostomy tube over catheter into stoma and remove catheter without dislodging tracheostomy tube.

Begin cardiopulmonary resuscitation with mouth-to-mouth breaths, following universal precautions. Cover trach stoma with your thumb if an air leak is present. Initiate the emergency plan.

Aspiration of foreign material (e.g., food, sand)

Suction first. Using the manual resuscitator bag before suctioning may force aspirate into lungs.

Give breaths with resuscitation bag after initial suctioning.

Check air movement.

Add saline and give breaths with resuscitation bag. Repeat suctioning. Repeat above steps until aspirated secretions are clear or gone.

If tracheostomy tube remains blocked by foreign material, change tracheostomy tube. Check air movement.

Give breaths with resuscitation bag if indicated.

Administer oxygen if prescribed in emergency plan.

Bronchospasm (wheezing) also may occur. The student may require medication.

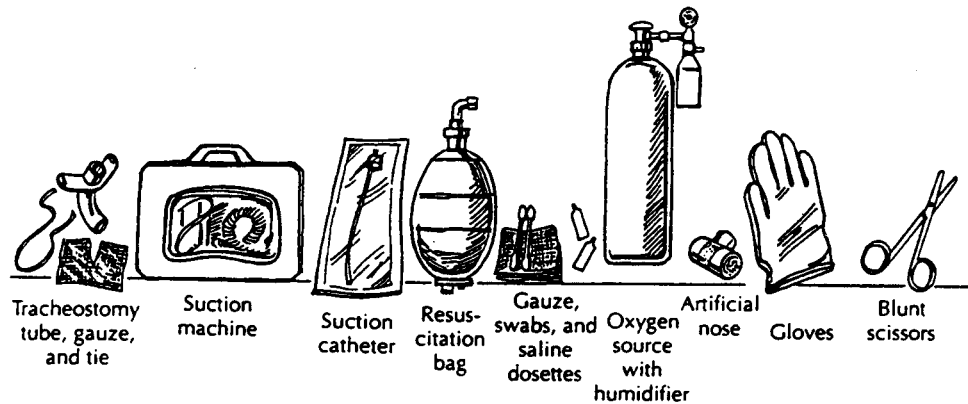
Respiratory distress or arrest can occur with any aspiration. Be prepared to initiate emergency plan. Begin cardiopulmonary resuscitation after suctioning, if needed. Notify family and physician.

PROCEDURE FOR CHANGING A TRACHEOSTOMY TUBE

PROCEDURE

1. Wash hands.

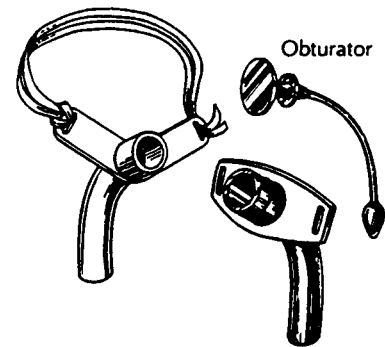
2. Assemble equipment:



- Prescribed type and size of tracheostomy tube for student
- Twill tape or other ties
- Obturator if applicable
- Blunt scissors
- Stethoscope
- Resuscitation bag
- Oxygen, if ordered
- Suctioning device and supplies

Always have a clean tracheostomy tube available and ready for use.

The obturator is used as a guide for insertion.



- Syringe if cuffed
- Sterile water-soluble lubricant or sterile saline
- One size smaller tracheostomy tube
- Blanket roll, if needed
- Gloves

Never use Vaseline or oil-based lubricants.

To position student's neck.

3. Explain procedure to the student at his or her level of understanding.

By encouraging the student to assist in the procedure, the caregiver helps the student achieve maximum self-care skills.

4. Position the student as ordered.

Have small children and infants lie on their backs with a blanket roll under the shoulders.

5. Wash hands.

6. Open tracheostomy tube package.
7. Put on gloves.
8. Put obturator into clean tracheostomy tube, if applicable.
9. Attach tracheostomy ties to tube.
10. Lubricate end of tracheostomy tube with water-soluble lubricant or sterile saline.
11. Suction tracheostomy and nose and mouth, if needed.
12. Give two to four breaths with resuscitation bag, if indicated.
13. Have assistant hold old tube in place while cutting the ties.
14. When the new tube is ready (in hand), have assistant remove old tube.
15. If the tube does not have an obturator, insert the clean (new) tube at a right angle to the stoma, rotating it downward as it is inserted. If an obturator is present, insert tube straight into stoma. Hold in place until secured.
16. If an obturator is used, immediately remove it after the tube is inserted. Insert inner cannula at this time. Hold in place until secured.
17. Listen and feel for air movement through tracheostomy tube.
18. Secure tube in place with ties or holder.
19. While assistant is holding the new tube in place, listen with stethoscope to assess breath sounds. Watch chest rise with breath.
20. Do skin care, if needed (see student-specific guidelines), and reapply gauze around and under tracheostomy tube and ties.
21. Give two to four breaths with resuscitation bag and suction if needed.
22. Discard used equipment according to universal precautions guidelines (see Chapter 5).
23. Student may resume previous activities.
24. Remove gloves and wash hands.
25. Document procedure and problems on student's log sheet.

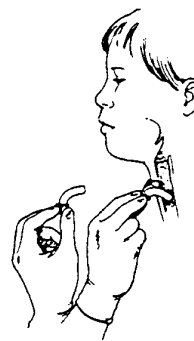
Keep tube clean. Do not touch curved part of tube.

Some students may have a Velcro holder or other means of securing tracheostomy tube around neck.

This makes airway as clear as possible.

If oxygen is used, make sure tubing is attached and oxygen is flowing.

If tube is being changed by one person, do not cut ties until clean tracheostomy tube is in hand.



Hold the tracheostomy tube in place at all times. A person is unable to breathe when the obturator is in place in the tracheostomy tube.

Observe the student for signs of distress (e.g., blueness, agitation, shortness of breath). The tracheostomy ties should be tied in a double knot. The ties should be loose enough to slip one finger between the ties and the neck. A small amount of bleeding may occur around stoma or be in secretions after a tracheostomy change. If unusual or persistent bleeding is present, notify the family and seek medical attention.

Save metal tracheostomy tube and send home to be sterilized.

Notify family of any changes in the student's usual pattern.

11

Student's name: _____

Person trained: _____

Position: _____

Tracheostomy Tube Care**Skills Checklist**

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Tracheostomy tie or tracheostomy tube holder							
2. One half hydrogen peroxide and one half normal saline or distilled water							
3. Cotton-tipped applicators							
4. Pipe cleaners							
5. Tracheal gauze or sponges							
6. Two clean containers							
7. Gloves							
D. Procedure:							
1. Washes hands							
2. Assembles supplies							
3. Positions student and explains procedure							
4. Washes hands thoroughly and puts on gloves							
5. Removes old gauze or sponges from tracheostomy							
6. Cleans stoma with hydrogen peroxide and cotton swabs							
7. If tracheostomy has inner cannula, removes inner cannula							
8. Replaces old tracheostomy ties or holder with a new one							
a. Holds flange, cuts old ties, and removes ties or holder							
b. Replaces used ties or holder							
c. Ties ends securely with double knot or secure holder							
d. Inserts tracheostomy sponge under the tracheostomy tube phalanges							

12

(continued)

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Tracheostomy Tube Care Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
9. Cleans removed inner cannula:							
a. Soaks inner cannula in one half hydrogen peroxide and one half normal saline or distilled water and cleans with a small brush, pipe cleaners, or cotton swabs							
b. Rinses with saline							
c. Replaces inner cannula and locks in place							
10. Discards cleaning solution							
11. Removes gloves and washes hands							
12. Documents procedure and observations							
13. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

Tracheostomy Tube Changes (Cuffed/Cuffless) Skills Checklist

Student's name: _____

Person trained: _____

Position: _____

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. In a school setting, this procedure should be done only in an emergency situation. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Type and size of tracheostomy tube							
2. Twill tape or other ties							
3. Obturator, if applicable							
4. Stethoscope							
5. Resuscitation bag							
6. Oxygen, if ordered							
7. Suctioning devices and supplies							
8. Water-soluble lubricant or sterile saline							
9. One size smaller tracheostomy tube							
10. Blanket roll, if needed							
11. Gloves							
12. Syringe, if cuffed tube							
D. Procedure:							
1. Washes hands							
2. Assembles equipment							
3. Explains procedure							
4. Washes hands							
5. Opens package							
6. Puts on gloves							
7. Removes from package; if cuffed tube, tests cuff							
8. Puts obturator into tracheostomy tube							
9. Attaches ties							
10. Lubricates tube							
11. Positions student							

13

(continued)

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Tracheostomy Tube Changes (Cuffed/Cuffless) Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
12. Suctions tracheostomy, nose, and mouth, if needed							
13. Gives two to four breaths with resuscitation bag, if needed							
14. Cuts ties							
15. If cuffed tracheostomy tube, removes air from cuff with syringe							
16. With new tube ready, removes old tube							
17. If tube does not have obturator, inserts tube at right angle to stoma. Holds in place until secured.							
18. If tube has obturator, inserts tube straight into stoma; immediately removes obturator after tube insertion							
19. Inserts inner cannula							
20. Listens and feels for air movement through tube. Watches chest rise with breath.							
21. If tube has cuff, inflates cuff with prescribed amount of air							
22. Secures tracheostomy tube in place with ties or holder							
23. Listens for breath sounds with stethoscope. Watches chest rise and fall with breath from resuscitation bag.							
24. Does skin care if needed; reapplies gauze around and under tracheostomy and ties							
25. Gives two to four breaths with resuscitation bag; suctions, if needed							
26. Discards used equipment appropriately							
27. Removes gloves and washes hands							
28. Documents procedure and observations							
29. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

Respiratory Emergencies—Accidental Removal of the Tracheostomy Tube Skills Checklist

Student's name: _____

Person trained: _____

Position: _____

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies Go-Bag supplies (see p. 355), including:							
1. Emergency phone number list							
2. Spare tracheostomy tube with ties or holder attached and obturator							
3. Water-soluble lubricant—jelly or saline							
4. Blunt scissors							
5. Suction supplies and machine							
6. Gloves							
7. Gauze or sponges							
8. Manual resuscitator bag							
D. Procedure:							
1. Describes recognition of problems:							
a. Respiratory distress							
b. Finding tracheostomy tube out of trachea							
c. Low-pressure alarm (ventilator)							
2. Preparation and prevention:							
a. Has spare tracheostomy tube with student at all times							
b. Posts emergency numbers							
c. Answers alarms promptly							
d. Keeps tracheostomy tube midline and straight							
e. Knows cardiopulmonary resuscitation							
3. Action:							
a. Repositions tube if possible or removes old tracheostomy tube and replaces with spare tube (see p. 266)							
b. Assesses student							
c. Calls for emergency help, if needed							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

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Respiratory Emergencies— Blocked Tracheostomy Tube Skills Checklist

Student's name: _____

Person trained: _____

Position: _____

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies Go-Bag supplies (see p. 355), including:							
1. Emergency phone number list							
2. Spare tracheostomy tube with ties or holder attached and obturator							
3. Water-soluble lubricant or saline							
4. Blunt scissors							
5. Suction supplies and machine							
6. Gloves							
7. Gauze or sponges							
8. Manual resuscitator bag							
D. Procedure:							
1. Describes recognition of problems:							
a. Respiratory distress							
b. Air will not go into lungs with a resuscitator bag							
c. Suction catheter will not pass through tracheostomy tube							
d. High-pressure alarm (ventilator)							
2. Preparation and prevention:							
a. Has spare tracheostomy tube with student at all times							
b. Has emergency supplies with student at all times							
c. Posts emergency numbers							
d. Keeps tracheostomy tube humidified properly							
e. Maintains routine tracheostomy tube changes							
f. Always answers alarms promptly							
g. Knows cardiopulmonary resuscitation							

(continued)

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Respiratory Emergencies— Blocked Tracheostomy Tube Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
3. Action:							
a. Puts on gloves							
b. Asks student to cough							
c. Puts several drops of saline in tracheostomy tube and suctions							
d. Changes tracheostomy tube or replaces inner cannula with spare and checks air movement							
e. Gives breaths with resuscitator bag							
f. Calls for emergency help and begins CPR, if needed							

Checklist content approved by: _____

Parent/Guardian signature _____ Date _____

Student's name: _____

Person trained: _____

Position: _____

Respiratory Emergencies—Aspiration Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies Go-Bag supplies (see p. 355), including:							
1. Suction supplies and machine							
2. Emergency phone number list							
3. Spare tracheostomy tube with ties or holder attached and obturator							
4. Blunt scissors							
5. Gloves							
6. Gauze or sponges							
7. Oxygen, if prescribed							
8. Manual resuscitator bag							
D. Procedure:							
1. Describes recognition of problems:							
a. Seeing student "breathe in" food, liquid, or vomit							
b. Seeing signs of aspiration (e.g., coughing, choking, turning blue)							
2. Preparation and prevention:							
a. Keeps suction catheters and saline with student at all times							
b. Uses caution when feeding and suction before feeding, if ordered							
c. Turns student's head to side and is sure tracheostomy tube opening is covered if vomiting occurs							
d. Posts emergency numbers							
e. Knows cardiopulmonary resuscitation							
3. Action:							
a. Puts on gloves, suction immediately—does not give breaths with resuscitation bag							
b. Gives breaths with bag after initial suctioning							

(continued)

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Respiratory Emergencies—Aspiration Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
c. Checks air movement							
d. Adds saline and gives breaths with resuscitation bag, repeats suctioning, and repeats Steps c and d until aspirated secretions are clear or gone							
e. If tracheostomy tube remains blocked by foreign material, changes tracheostomy tube							
f. Checks air movement							
g. Gives breaths with resuscitation bag if indicated							
h. Gives oxygen if prescribed							
i. If respiratory distress continues, initiates emergency plan and begins CPR, if needed							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

MANUAL RESUSCITATION BAG

PURPOSE

A manual resuscitator or self-inflating bag is used to deliver breaths manually when a student is unable to breathe on his or her own. This device may be used with a mask to cover the nose and mouth or with a special adaptor for a tracheostomy tube.

Situations in which a manual resuscitator may need to be used include the following:

- Student is having difficulty breathing on his or her own.
- A ventilator malfunctions.
- Routine respiratory care for a student is needed.
- Student stops breathing and needs to be resuscitated.

Students who have tracheostomies or who use ventilators should have manual resuscitation bags with them at all times.

SUGGESTED SETTINGS

In optimal circumstances, manual resuscitation (e.g., ambuing, bagging) should be done in an area designated for health care procedures. In an emergency, it must be done wherever needed.

SUGGESTED PERSONNEL AND TRAINING

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

Manual resuscitation should be performed by a registered nurse or a respiratory therapist or a delegated adult with proven competency-based training in appropriate techniques and problem management, following state medical and nursing practice standards.

If the trained caregiver and back-up personnel are unavailable on a given school day, the student should not attend school. However, an optional arrangement may be made between the school and the family so that someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student who may require the use of a manual resuscitator must receive general training that covers the student's special health care needs, potential problems, and how to implement the established emergency plan.

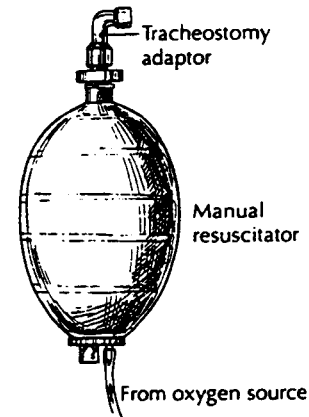
PROCEDURE FOR USING A MANUAL RESUSCITATOR WITH TRACHEOSTOMY

PROCEDURE

1. Wash hands.
2. Assemble equipment:
 - Oxygen source with appropriate tubing if needed
 - Manual resuscitator
 - Adaptor for tracheostomy tube
 - Go-bag items
3. Explain the procedure to the student at his or her level of understanding.
4. Check that resuscitator is functioning properly.
5. Position student.
6. Attach resuscitator bag to tracheostomy tube.
7. If the student is able to breathe independently, coordinate the manual breaths with his or her own breaths. Give a breath by squeezing the resuscitation bag as the student begins to inhale (i.e., chest begins to rise).

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.



By encouraging the student to assist in the procedure, the caregiver helps the student achieve maximum self-care skills.

Place adaptor, which is connected to the bag, against a gauze or tissue in hand. Squeeze bag to be sure it is functioning. (If it is functioning, slight resistance will be felt.)

Position may vary; see student-specific guidelines. If oxygen is to be used, make sure tubing is attached and that oxygen is flowing.

Hold tracheostomy tube with one hand to prevent accidental dislodgement while attaching adaptor to it.



If you feel resistance and/or the student looks distressed, be sure you are giving breaths with the student's own effort and that the tube is patent.

8. If the student is unable to breathe on his or her own, squeeze the resuscitation bag at a regular rate to deliver prescribed breaths per minute.
9. Remove resuscitation bag from tracheostomy tube.
10. Wash hands.
11. Document procedure and problems on student's log sheet. 14

If the student has no breathing rate prescribed, a standard range of breaths per minute is
20–24 for infants
16–20 for children
12–16 for adolescents and adults
Hold tracheostomy tube with one hand to prevent pulling/dislodging it.

Notify the family of any problem.

Student's name: _____

Person trained: _____

Position: _____

Go Bag Supplies Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Identifies use of each essential supply:							
1. Resuscitator bag							
2. Extra tracheostomy tube with ties and obturator (if indicated)—one the same size (if student has a cuffed tracheostomy tube, have an uncuffed tube of same size available. Second tracheostomy tube should be one size smaller.							
3. Syringe (3 cc)							
4. Saline vials							
5. Suction catheters							
6. Bulb syringe							
7. Portable suction machine							
8. Blunt scissors							
9. Tissues							
10. Cotton-tipped applicators and pipe cleaners							
11. Hydrogen peroxide							
12. Gloves							
13. Tracheal gauge or sponges							
14. Water-soluble lubricant or saline							
15. Passive condenser							
16. Emergency phone numbers							
17. Go Bag list							
18. Other individualized items							
19. Emergency telephone number list							
C. Demonstrates plan for checking emergency supplies							

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Checklist content approved by: _____

Parent/Guardian signature _____ Date _____

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Manual Resuscitator Bag with Tracheostomy Skills Checklist

Student's name: _____

Person trained: _____

Position: _____

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
C. Identifies supplies:							
1. Oxygen source with appropriate tubing if needed							
2. Manual resuscitator							
3. Adaptor for tracheostomy tube							
4. Go-Bag items							
D. Procedure:							
1. Washes hands							
2. Positions student and explains procedure							
3. Checks that manual resuscitator is functioning properly							
4. Attaches resuscitator bag to tracheostomy tube							
5. Coordinates manual breaths with student's own breaths, if student breathes independently							
6. Squeezes manual resuscitator at regular rate to give prescribed breaths per minute, if student unable to breathe independently							
7. Removes resuscitation bag from tracheostomy tube when appropriate							
8. Washes hands							
9. Documents procedure and observations							
10. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

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PURPOSE

Oxygen provides for body functions, relieves shortness of breath, and reduces the workload of the heart. Oxygen use is indicated for physical conditions in which a student is unable to get enough oxygen into the body or needs more oxygen, such as chronic lung conditions (e.g., bronchopulmonary dysplasia [BPD], cystic fibrosis [CF], heart problems).

SUGGESTED SETTINGS

When in contact with a student using oxygen, the following warning is in effect:

WARNING:

- THERE SHOULD BE NO SMOKING, OPEN FLAME, OR HEAT SOURCE CLOSE TO THE OXYGEN; THESE MAY INCREASE THE RISK OF FIRE.
- EQUIPMENT AND OXYGEN SUPPLY MUST BE CHECKED AT LEAST DAILY, OR MORE OFTEN, DEPENDING ON THE EQUIPMENT.

SUGGESTED PERSONNEL AND TRAINING

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

The school nurse or other adult with proven competency-based training in appropriate techniques and problem management may administer oxygen through a nasal cannula or mask. Use of a tracheostomy collar may require a registered nurse or respiratory therapist with training, depending on the care needs of the student with a tracheostomy. Any school personnel who have regular contact with a student who requires oxygen must receive general training that covers the student's specific health care needs and potential problems and must understand how to implement the established emergency plan.

The basic skills checklists on pages 76, 79, 81 can be used as a foundation for competency-based training in appropriate techniques. Specific procedures for oxygen use are outlined step by step. Once the procedures have been mastered, the completed checklists serve as documentation of training.

THE INDIVIDUALIZED HEALTH CARE PLAN: ISSUES FOR SPECIAL CONSIDERATION

Each student's individualized health care plan (IHCP) must be tailored to the individual's needs. The following section covers the procedure for oxygen use and possible problems and emergencies that may arise. It is essential that this section be reviewed before writing the IHCP.

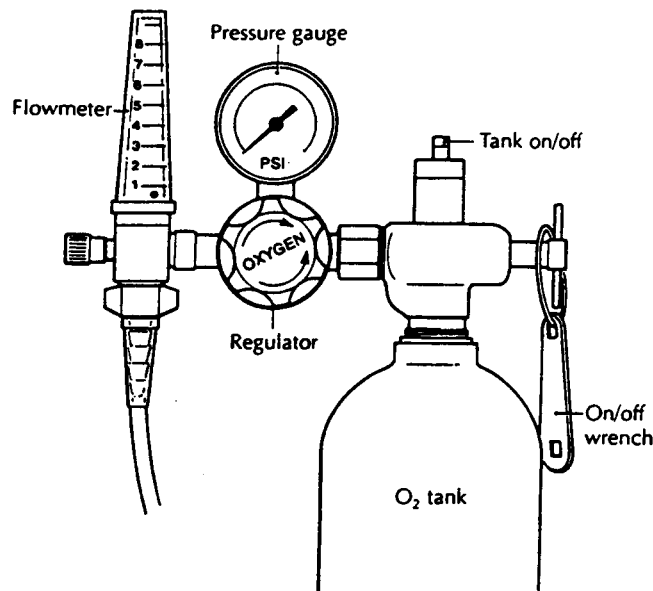
A sample plan is included in this manual. It may be copied and used to develop a plan for each student. For a student who requires oxygen, the following items should receive particular attention:

- Student's underlying condition and possible problems associated with the condition or treatment
- Oxygen safety precautions including posting of "oxygen in use" warnings
- Spare oxygen supply and safe storage when not in use
- Adaptation of classroom for necessary equipment, storage, and transport (e.g., length of tubing, oxygen source)
- Signs and symptoms shown by the student when not receiving adequate oxygen (e.g., cyanosis, agitation, distress)
- Student's baseline status, including color, respiratory rate, pulse, and blood pressure
- Student's ability to request oxygen or assistance
- Percentage and/or liter flow of oxygen prescribed (for daily use and emergencies)
- Access to oxygen supply throughout school building (i.e., portable or stationary)

- Latex allergy alert
- Universal precautions (Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student)

OXYGEN SOURCES

Oxygen gas Pure oxygen gas is stored under pressure in a metal tank or cylinder. Tanks come in different sizes, ranging from small (portable) to large (stationary). The tank size used by the student depends on the amount of oxygen flow needed. The amount of oxygen available in the tank is indicated by the pressure gauge on the tank.



Oxygen concentrator This is an electronically powered machine that removes nitrogen from room air and concentrates the remaining oxygen for delivery to the student. This type of system delivers a lower concentration of oxygen at low liter flows. An oxygen concentrator requires an electrical outlet and is not portable. Some units may contain a back-up battery in the event of a power failure. Each unit has an air filter that requires periodic cleaning.

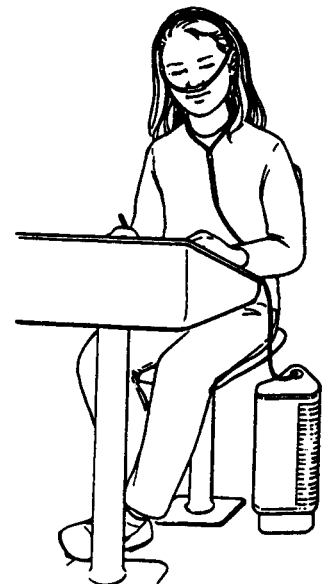
Additional equipment for oxygen concentrator systems includes the following:

- Humidification source
- Oxygen tubing, mask, cannula, or tracheostomy collar
- Emergency oxygen tank for power failure

Oxygen liquid Oxygen liquid systems utilize a thermal storage container that keeps the pure oxygen as a liquid at -300° Fahrenheit. A smaller portable container (i.e., thermos) usually is used to deliver the oxygen to the student. Depending on the prescribed liter flow for the student, the thermos may require refilling from the larger storage tank.

Additional equipment for both gas and liquid systems includes the following:

- Tank stand or carrier
- Regulator with pressure gauge and flowmeter
- Wrench for gas tank valve
- Humidification source
- Oxygen tubing, mask, cannula, or tracheostomy collar



OXYGEN SAFETY PRECAUTIONS

- Do not smoke or allow open flames near oxygen. Store oxygen away from heaters, radiators, and hot sun.
- Never permit oil, grease, or highly flammable material to come into contact with oxygen cylinders, liquid oxygen, valves, regulators, or fittings. Do not lubricate with oil or other flammable substances, and do not handle equipment with greasy hands or rags.
- Never put anything over an oxygen gas tank.
- Know the name of the home oxygen supply company contact person. Have the telephone number posted in an obvious place and on the emergency plan.
- Return any defective equipment to the authorized company for replacement.
- Have spare oxygen readily accessible based on the student's needs. This should be stored safely in a secure place.
- Keep extra tubing and tank equipment (e.g., wrenches) in an easily accessible place.
- Protect dry regulator from becoming dislodged. A hissing noise may indicate a leak in system.
- Be sure that the tank (when using oxygen gas) is securely placed in its stand and cannot fall or be knocked over.
- Be careful that the oxygen tubing does not become kinked, blocked, punctured, or disconnected.
- Use only the flowmeter setting prescribed by the student's physician.
- Notify the fire department that oxygen is in use in the school.
- Secure the oxygen tank or liquid system for transport in an upright position. Make sure the gauge and valve stem are protected from damage.

Possible Problems that Require Immediate Attention for Students Requiring Oxygen

Observations

The student shows any of the following signs of respiratory distress:

- Shortness of breath or rapid breathing rate
- Agitation
- Blueness or pallor of the lips, nails, or earlobes
- Pulling in of the muscles at the neck or chest
- Confusion, dizziness, or headache
- Rapid or pounding pulse

The equipment and oxygen flow are adequate, but the student continues to show signs of respiratory distress, becomes unconscious, or has a respiratory arrest.

Reason/Action

Stay calm and reassure student.

Check student:

- *Position student to open airway. Make sure mouth, nose, or tracheostomy tube is not obstructed by food or mucus.*
- *Check tracheostomy tube placement.*
- *Make sure collar is not out of position or obstructing tracheostomy tube.*

Check equipment (check oxygen flow—if flow is weak or inadequate):

- *Make sure tank is not empty or defective. If so, replace with back-up tank.*
- *Make sure valve, regulator, and flowmeters are on proper settings.*
- *Make sure tubing is not blocked or kinked.*
- *Check all connections from oxygen source to student.*
- *Make sure tubing, mask, cannula, and collar are not blocked.*
- *Make sure humidifier bottle is properly attached.*
- *Make sure tubing is not obstructed by water collecting in it from condensed mist. Empty water from tubing frequently when using mist.*

May indicate the need for increased oxygen flow. Prior to school entry, obtain physician order for emergency oxygen use (percent and flow rate).

Initiate emergency procedure and notify family. Begin cardiopulmonary resuscitation if needed.

A Possible Problem that Does Not Require Immediate Attention

Observation

Redness, dryness, or bleeding of the skin

Reason/Action

May be due to irritation from the device or from insufficient humidity.

Notify family to discuss problem with physician.

Never use powders or petroleum products on the student's face.

General Information Sheet

Students Who Use Supplemental Oxygen

Dear (teacher, lunch aide, bus driver):

_____ [Student's name] has a condition that requires the use of additional oxygen. When used appropriately, this is a safe method that allows the student to be normally active. Oxygen is kept in a small tank or thermos and goes everywhere the student does. The oxygen is given to the student through a mask or small plastic tubing close to the student's nose. Students with tracheostomies receive oxygen through a collar that fits over the tube. Some students need oxygen continuously, while others may need it only intermittently.

Depending on the student's condition, she or he may be able to participate in many school activities with some modifications, which are determined by the school staff, the family, physician, and school nurse. **There should be no smoking or open flames in the room in which oxygen is being used. The oxygen tanks should not come into contact with oil, grease, greasy hands, or rags.**

It is recommended that you participate in cardiopulmonary resuscitation training. It is also important to learn how to recognize the warning signs of breathing problems.

The following staff members have been trained to deal with any problems that may arise with this student:

For more information about oxygen use or the student's needs, consult the school nurse or the family. 16

Using an Oxygen Cylinder

A pressurized tank or cylinder may be used as a source of oxygen. When using oxygen from a cylinder an oxygen regulator must be used to deliver the desired flow required for the student.

Procedure	Points to Remember
1. Assemble equipment <ul style="list-style-type: none">• Oxygen cylinder with key or wrench• Oxygen regulator with pressure gauge and flow meter• Humidification system• Tank stand• Delivery device (mask, cannula, trach shield) with oxygen tubing	<i>Although the configuration may differ, all regulators have a pressure gauge and a flow meter.</i>
2. Wash hands	
3. Prepare tank and regulator <ul style="list-style-type: none">• Place tank in stand near student• Attach the regulator to the cylinder by inserting it into the cylinder valve.• Tighten the inlet nut with the key or wrench.	<i>Be careful when moving the tank that it doesn't fall or bang against anything.</i> <i>Before attaching the regulator, open the cylinder valve slightly then quickly close it. This clears the valve of any dust.</i>
4. Slowly turn the tank on	<i>If the valve is opened too rapidly, the sudden inrush of high pressure gas can damage the regulator.</i>
5. Check the pressure in the tank	
6. Estimate the amount of time the tank will last	
7. Prepare the humidification unit by adding distilled water to the reservoir	<i>Oxygen is very drying to mucous membranes.</i>
8. Attach the humidifier to the regulator	<i>As it bubbles through the water, the oxygen will pick up moisture.</i>

9. Connect the specified delivery device with oxygen tubing to the cylinder.
(See Procedures for Oxygen Delivery by Mask, Nasal Cannula & Trach Shield)
10. Adjust oxygen flow on flow meter to the prescribed liters/min
11. Store tank safely
12. Wash hands
13. Document procedure on student log

Student's name: _____

Person trained: _____

Position: _____

Oxygen Cylinder Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
5. States oxygen safety procedures							
C. Identifies supplies:							
1. Oxygen cylinder with key							
2. Oxygen regulator							
3. Flowmeter							
4. Delivery device with oxygen tubing							
5. Humidifier, if needed							
6. Tank stand							
D. Procedure:							
1. Positions student and explains procedure							
2. Washes hands							
3. Prepares tank and regulator							
4. Turns on tank							
5. Checks pressure in tank							
6. Estimates amount of time tank will last							
7. Connects delivery device and humidifier (if needed) to cylinder							
8. Adjusts flow to prescribed LPM; checks delivery device to make sure oxygen is coming out							
9. Provides oxygen to student using prescribed delivery device							
10. Monitors PSI, flow, and time while tank is in use							
11. Monitors student for hypoxia while oxygen is in use							
12. Turns off tank before turning off flowmeter, when tank is no longer needed or must be changed; removes delivery device from student							
13. Stores tank safely							

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(continued)

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Oxygen Cylinder Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
14. Washes hands							
15. Documents procedure and observations							
16. Reports any changes to family							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

Using Liquid Oxygen

Liquid oxygen systems are smaller and more compact than cylinders. The oxygen is compressed in a thermal storage container which keeps it in a liquid state until released for use when the regulator valve is opened.

Procedure

Points to Remember

1. Assemble equipment
 - Liquid oxygen system
 - Delivery device (mask, cannula, trach shield) with oxygen tubing
 - Humidifier if required
 - Tank carrier
2. Wash hands
3. Prepare liquid oxygen system
 - Be careful when handling due to potential for flammability.*
4. Attach humidifier to liquid oxygen
 - Oxygen is drying to mucous membrane*
5. Connect delivery device with oxygen tubing to the liquid oxygen system
6. Adjust flow to prescribed liters/min (LPM)
7. Provide oxygen to student using the prescribed delivery system. (See Procedures for Oxygen Delivery by Mask, Nasal Cannula & Trach Shield)
8. Monitor the flow while using
9. Monitor the student for hypoxia (pallor or turning "blue") while oxygen is in use
10. Document the procedure and problems on student log.
11. Monitor the level of the liquid daily
 - This tank will run out quickly and may evaporate over time. It is best used for transport and mobility.*

Student's name: _____

Person trained: _____

Position: _____

Oxygen Liquid System Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
5. States oxygen safety procedures							
C. Identifies supplies:							
1. Liquid oxygen system							
2. Delivery device with oxygen tubing							
3. Humidifier, if needed							
D. Procedure:							
1. Positions student and explains procedure							
2. Washes hands							
3. Prepares unit							
4. Checks level of fluid							
5. Connects delivery device and humidifier to liquid system							
6. Adjusts flow to prescribed LPM							
7. Checks delivery device to make sure oxygen is coming out							
8. Provides oxygen to student using prescribed delivery device							
9. Monitors flow while in use							
10. Monitors student for hypoxia while oxygen is in use							
11. Turns off cylinder before turning off flow-meter, when cylinder is no longer needed; removes delivery device from student							
12. Washes hands							
13. Monitors level of the liquid daily and stores cylinder safely							
14. Documents procedure and observations							
15. Reports any changes to family							

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Checklist content approved by:

Parent/Guardian signature _____ Date _____

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Using an Oxygen Concentrator

An oxygen concentrator removes nitrogen from room air and concentrates the remaining oxygen for delivery to a student. Oxygen concentrators are electrically operated and are not usually portable.

Procedure

Points to Remember

1. Assemble equipment
 - Oxygen concentrator
 - Flow meter
 - Delivery device (mask, cannula, trach shield) with oxygen tubing
 - Humidifier if required
2. Wash hands
3. Check external foam filter on oxygen concentrator
 - Wash external filter under hot running water at least once a week. Replace as needed.*
4. Plug in and turn concentrator
5. Test power failure alarms
6. Fill humidifier reservoir with distilled water and attach to concentrator
 - Oxygen is drying to mucous membranes. Reservoir needs to be washed daily with mild soap and water.*
7. Connect delivery device with oxygen tubing to the concentrator
8. Adjust flow to prescribed liters/min (LPM)
9. Provide oxygen to the student using the prescribed delivery device. (See Procedures for Oxygen Delivery by Nasal Cannula, Mask and Trach Shield)
10. Monitor the flow while in use
11. Monitor the student for hypoxia (pallor or turning "blue") while in use.
12. Document the procedure and problems on student log.

Student's name: _____

Person trained: _____

Position: _____

Oxygen Concentrator Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Preparation:							
1. Identifies student's ability to participate in procedure							
2. Reviews universal precautions							
3. Identifies where procedure is done							
4. Identifies possible problems and appropriate actions							
5. States oxygen safety procedures							
C. Identifies supplies:							
1. Oxygen concentrator							
2. Flowmeter							
3. Delivery device with oxygen tubing							
4. Humidifier, if needed							
D. Procedure:							
1. Positions student and explains procedure							
2. Washes hands							
3. Checks filter							
4. Turns on concentrator							
5. Tests power-failure alarms							
6. Connects delivery device to concentrator with oxygen tubing							
7. Adjusts flow to prescribed LPM; provides oxygen to student using prescribed delivery device							
8. Checks delivery device to make sure oxygen is coming out							
9. Monitors flow while in use							
10. Monitors student for hypoxia while oxygen is in use							
11. Turns off tank before turning off flowmeter, when tank is no longer needed; removes delivery device from student							
12. Washes hands							
13. Documents procedure and observations							
14. Reports any changes to family							

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Checklist content approved by:

Parent/Guardian signature _____ Date _____

Format adapted from Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program. (1987). *Getting it started and keeping it going: A guide for respiratory home care of the ventilator assisted individual*. New Orleans, LA: Author; adapted by permission.

Children and Youth Assisted by Medical Technology in Educational Settings (2nd ed.) © 1997 Paul H. Brookes Publishing Co., Baltimore.

PROCEDURE FOR USING A NASAL CANNULA

A nasal cannula is used to deliver a low-to-moderate concentration of oxygen. It can be used as long as nasal passages are open; a deviated septum, swelling of the passage, mucus, or polyps may interfere with adequate oxygen intake. A nasal cannula is easy to use. Eating, talking, and coughing are possible.

PROCEDURE

1. Wash hands.
2. Assemble equipment
 - Oxygen source and backup
 - Cannula and tubing (plus extra connecting tubing)
 - Humidity source, if needed
 - Adaptor for connect tubing
 - Scissors
3. Explain procedure at the student's level of understanding.
4. Wash hands.
5. Attach cannula tubing to oxygen source securely.
6. Set liter flow on the flowmeter as prescribed by the physician. **Never change this setting without first contacting the physician.** Turn on the oxygen source.
7. Check cannula prongs to make sure that oxygen is coming out.

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.

Extra connecting tubing may be used to increase mobility.

Scissors are used to cut adaptor to size. By encouraging the student to assist in the procedure, the caregiver is helping the student to achieve maximum self-care skills.

Make sure a proper adaptor is available for the oxygen source. Check that tank has enough oxygen. Attach humidifier, if ordered. Check that all pieces are secured tightly to prevent leaks.

A highly visible information card stating oxygen liter flow must be attached to the regulator. A too-high oxygen flow may irritate the nose. Oxygen liter flow can be ordered as a set liter flow rate (e.g., 3 liters per minute) or as a range (e.g., 3–5 liters per minute) based on student's needs. For emergencies, see page 269.

Hold them up to your hand or check to feel for flow coming out. If no flow is felt, check oxygen supply, connections, flow rate, and tubing for obstruction.

8. Insert prongs into student's nose. Make sure both prongs are in the nostrils.



9. Wash hands.
10. Document procedure and problems on student's log sheet. 20

Gently insert prongs into the student's nostrils (one in each side). Loop the tubing over each ear then under the chin; secure by sliding the clasp up under the chin. Make sure that it is comfortable for the student. If the student is not comfortable, the cannula tubing may be secured behind the head rather than under the chin.

Report to family any changes in student's pattern.

PROCEDURE FOR USING AN OXYGEN MASK

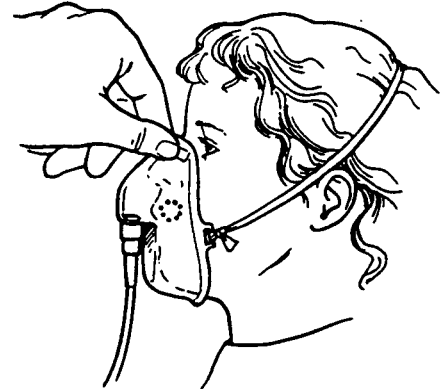
An oxygen mask can deliver higher or lower concentration of oxygen than the nasal cannula and is useful when nasal passages are blocked.

PROCEDURE

1. Wash hands.
2. Assemble equipment:
 - Oxygen source and backup
 - Appropriate size mask and tubing (plus a spare)
 - Extra connecting tubing plus adaptor
 - Humidity source, if needed
3. Explain procedure at the student's level of understanding.
4. Set oxygen flow on flowmeter to the rate prescribed by the physician. **Do not change setting without first contacting the physician.** Turn on the oxygen source.
5. Check that oxygen flow is coming out of the mask.
6. Place the mask over the student's nose and mouth.
7. Wash hands.
8. Document procedure and problems on student's log sheet. 21

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.



By encouraging the student to assist in the procedure, the caregiver helps the student achieve maximum self-care skills.

Excessive flow rates may cause irritation to the skin. A highly visible information card stating oxygen liter flow must be attached to the regulator. Oxygen liter flow can be ordered as a set liter flow rate (e.g., 3 liters per minute) or as a range (e.g., 3–5 liters per minute) based on student's needs. For emergencies, see page 269.

Hold mask up to your cheek to feel gas flow. If no flow is felt, check oxygen supply, connections, flow rate, and tubing for obstruction.

Tighten the elastic band over the student's head and pinch mask over the bridge of the nose for a good fit. Make sure that the student is comfortable with the mask and that the mask does not touch the eyes.

Report to family any changes in student's usual pattern.

**Oxygen Delivery by Nasal Cannula or Mask
Skills checklist**

Student's Name: _____

Person Trained: _____

Position: _____

Instructor: _____

	Demo	Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure.							
B. States PRECAUTIONS.							
C. Assembles Supplies:							
1. Oxygen source							
2. Cannula or mask and tubing							
3. Humidity source if required							
4. Adapter to connect tubing							
5. Scissors							
D. Steps:							
1. Washes hands and explains procedure to student							
2. Oxygen source using humidifier if required							
3. Sets liter blow as prescribed							
4. Assures oxygen air flow through cannula or mask							
5. Places cannula in both nares or places mask over student's mouth and nose							
6. Washes hands							
7. Documents procedure and problems							

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Checklist content reviewed by:

Parent/Lawful Custodian

Date

PROCEDURE FOR USING A TRACHEOSTOMY COLLAR

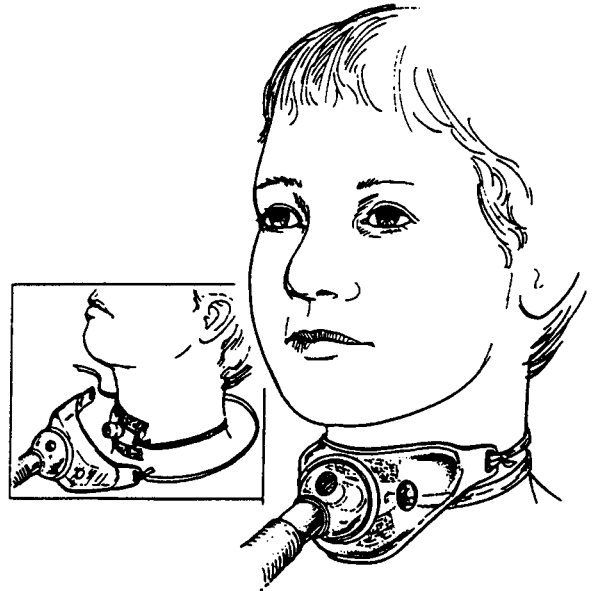
The tracheostomy collar is one means of delivering oxygen or humidified air to the tracheostomy. The tracheostomy collar may be used with a humidifying device and tubing to prevent dry and/or thick secretions from plugging the tracheostomy and to administer oxygen to the student.

PROCEDURE

1. Wash hands.
2. Assemble equipment:
 - Extra nebulizer/humidifier
 - Heating device, if indicated
 - Wide bore tubing
 - Tracheostomy collar
 - Oxygen tubing
 - Nipple adaptor
 - Oxygen source, if needed
3. Explain procedure at the student's level of understanding.
4. Set up humidification device.
5. Dial percent of oxygen as ordered.
6. Connect to compressed air/oxygen source. Turn on oxygen source. **Do not change setting without first contacting the physician.**
7. Connect to heater and/or humidifier if required.
8. Place one end of wide bore tubing on the collar and the other on the humidifier or heater.

POINTS TO REMEMBER

Anticipating the tasks to be done, the risk involved, and the personal protective equipment needed will enhance protection of both the caregiver and student.



By encouraging the student to assist in the procedure, the caregiver helps the student achieve maximum self-care skills.

There are several types of humidification devices. Check student-specific guidelines and set up according to specific instructions. Some students may require only compressed air.

A highly visible information card stating oxygen liter flow must be attached to the regulator. Oxygen liter flow can be ordered as a set liter flow rate (e.g., 3 liters per minute) or as a range (e.g., 3–5 liters per minute) based on student's needs. For emergencies, see page 269.

Some students may use cool mist. With prolonged humidification, moisture collection in the tubing can block the flow of air/oxygen and may require periodic removal.

- With compressed air/oxygen source on, look at mist at the end of tubing. You should see a fine mist when held up to the light.

Place collar on student's neck over tracheostomy tube in the midline.

Wash hands.

Document procedure and problems on student's log sheet.

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If this is not present, check that all connections are on securely and compressed air/oxygen is flowing. Turn on higher flow, then return to flow ordered to see if mist is present.

Adjust tracheostomy collar so that it is snug but not uncomfortable for student.

Report to family any change in student's usual pattern.

Student's Name: _____

Person Trained: _____

Position: _____

Oxygen Delivery by Trach Collar
Skills checklist

Instructor: _____

	Demo	Return Demonstration					
	Date	Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure.							
B. States PRECAUTIONS.							
C. Assembles Supplies:							
1. Oxygen source if needed							
2. Heating device if indicated							
3. Nebulizer/humidifier							
4. Oxygen tubing and trach collar							
5. Nipple adapter							
D. Steps:							
1. Washes hands							
2. Oxygen source or compressed air							
3. Sets liter flow as prescribed on oxygen source							
4. Prepares humidifier							
5. Connects one end of tubing to trach collar and the other end to the humidifier or heater							
6. Assures oxygen or air flow through tubing at trach collar (with humidifier use, a fine mist is observable)							
7. Place collar over tracheostomy site on student's neck							
8. Washes hands							
9. Documents procedure or problems							

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Checklist content reviewed by:

Parent/Lawful Custodian

Date

Apnea Monitor

I. Purpose

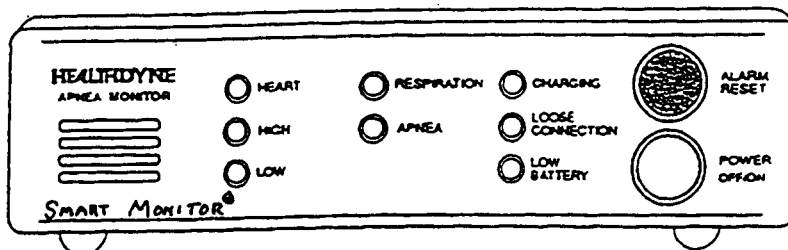
An apnea monitor is an electrical device that sounds an alarm when respirations become too slow or cease.

II. Suggested Settings

Generally, wherever the student is, but the setting should have an accessible working, grounded outlet.

III. Equipment ²⁵

Electrical outlet
Apnea monitor



IV. Suggested Personnel and Training

Use of an apnea monitor may be delegated by a registered nurse to un-licensed assistive personnel with proven competency-based training in appropriate techniques and problem management.

If the trained care-giver(s) and back-up personnel are unavailable on a given school day, the student should not attend school. However, an optional arrangement may be made between the school and the family, where the lawful custodian would be available to attend school to function as the care-giver for the student.

Any school personnel with regular contact with a student who requires an apnea monitor must receive general training, covering the student's special health care needs and potential problems as well as how to implement the established anticipated health crisis plan.

The basic skills checklist included at the end of this procedure can be used as a foundation for competency-based training in appropriate techniques. It outlines specific procedures step-by-step. Once the procedures have been mastered, the completed checklist serves as documentation of training.

V. Individualized Health Care Plan: Issues for Special Consideration.

Each student's Individualized Health Care Plan (IHCP) must be tailored to individual needs. The following section covers the procedure for use of apnea monitors as well as

possible problems and emergencies that may arise. It is essential that this section be reviewed before writing the IHCP.

A sample IHCP and Anticipated Health Crisis Plan are found in Appendix A. These may be copied and used to develop a plan for each student.

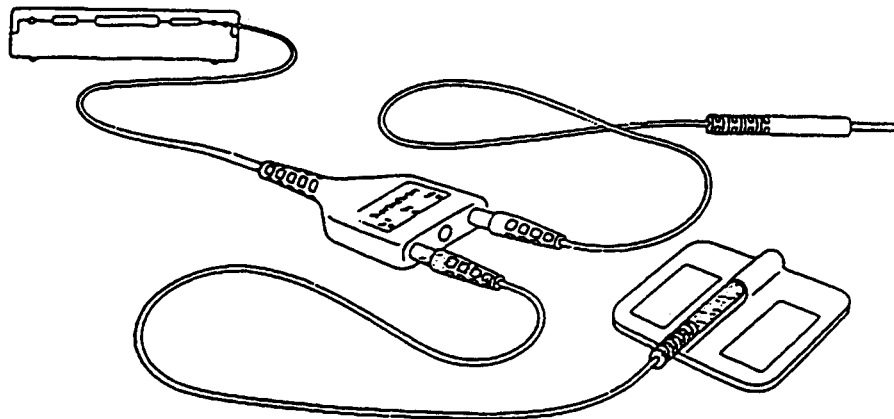
Procedure for use of an Apnea Monitor

Procedure

Points to Remember

1. Assemble equipment
 - Apnea Monitor
 - Electrode belt (optional)
 - Electrode cable
 - Lead wires
 - Electrodes
 - Alcohol or skin cleanser
2. Wash hands.
3. Assure skin site is clean using the alcohol or skin cleanser.
4. Place electrode belt on a flat surface facing up.
5. Connect lead wires to the electrodes.

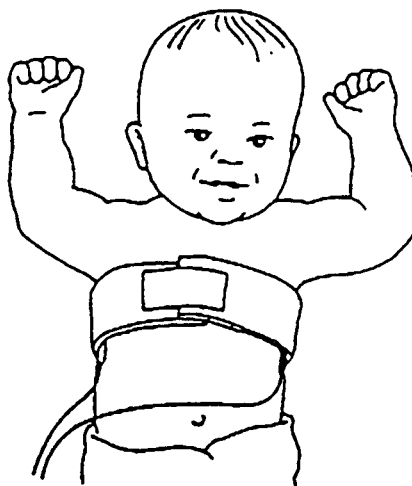
Assure the white lead is connected to the electrode to be placed over the student's chest on the right and the black lead wire on the left. 26



6. Electrodes should be connected to the belt with the smooth side up and pointing to the bottom of the belt.

7. Wrap the belt smoothly around the student so the electrodes are positioned to make contact with the chest wall halfway between the armpit and the bottom of the rib cage. ²⁷

One finger should fit tightly between the chest and belt. A loose belt can cause false alarms.



8. Connect the loose ends of the lead wires to the patient cable according to the color codes.
9. Turn on the monitor by pushing the power off/on button.
10. Note heart and respiratory rate indicators on monitor.

Push the wire into the cable connection until it "snaps" in place.

All the lights and the alarm will come on briefly.

The green Respiration light will blink with each chest movement. (It may also flash additional times when the student moves).

The apnea light will come on when a pause in breathing occurs which is longer than the limit prescribed by the physician, and a beeping alarm will sound.

The green "heart" light blinks with each heart beat.

If the heart rate is either higher or lower than the prescribed limit the corresponding red lights will come on and a beeping alarm will sound.

(The re-set button must be pressed to shut-off any of the alarms.)

The loose connection light will come on if there is a problem with any of the connections to the student and a continuous alarm will sound.

For units operated on internal batteries; The low battery light will come on and a continuous alarm will sound if the battery needs charging.

11. Adjust the sensitivity controls for respiratory and heart rates as prescribed.
12. Document the procedure and problems on student log. ²⁸

Use of Apnea Monitor Skills Checklist

Student's Name: _____

Person Trained: _____

Position: _____

Instructor: _____

	Demo	Return Demonstration					
	Date	Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure.							
B. Identifies Supplies							
1. Apnea monitor							
2. Electrode cable							
3. Lead wires							
4. Electrodes							
5. Alcohol or other skin cleaner							
C. Steps:							
1. Assembles supplies							
2. Washes hands							
3. Explains procedure and encourages student participation.							
4. Plugs monitor into wall outlet. Turn power on. Turn power off.							
5. Plugs electrode cable into monitor.							
6. Places electrodes on student's body appropriately.							
7. Attaches lead wires to cable.							
8. Attaches lead wires to electrodes.							
9. Turns monitor on.							
10. Demonstrates how to correlate heart and respiratory rate with indicators on the monitor and demonstrates how to adjust sensitivity controls.							
11. Identifies what to do when an alarm sounds and possible reasons an alarm may sound.							
12. Identifies aspects of general monitor care.							
13. Documents procedures and any problems.							
14. Notifies appropriate persons of any problems.							
15. Documents on student health record.							

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Checklist reviewed by:

Parent/Lawful Custodian

Date

Respiratory Assistance: Pulse Oximeter

I. Purpose

A pulse oximeter is an electrical apparatus for continuously determining the amount of oxygen in the blood. The monitoring is usually accomplished by measuring the amount of light transmitted through the skin using a small light sensitive probe taped in place over a finger or toe. By measuring the oxygen concentration of the blood in this manner, it is possible to know whether or not body tissues are adequately oxygenated. The oximeter screen will display a visible reading of the pulse rate and the oxygen concentration (Sa O₂). Additionally, an alarm will sound if oxygen concentration is too low. A normal oxygen saturation is greater than 94%.

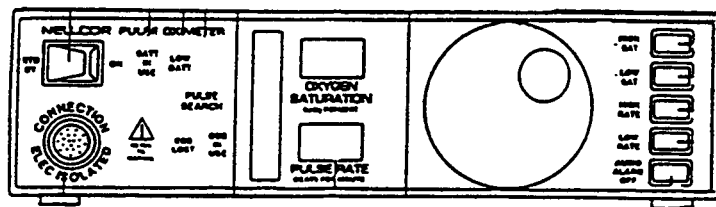
II. Suggested Setting

Any location in the school is appropriate for use of the oximeter, since it is generally ordered for continuous use.

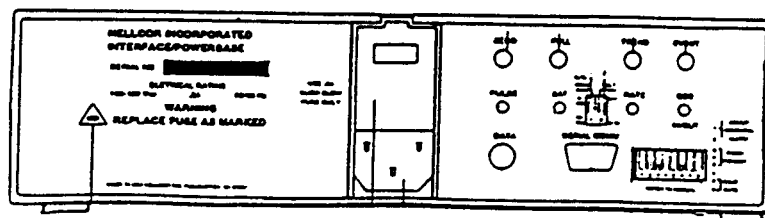
III. Special Equipment³⁰

1. Oximeter
2. Light - sensitive probe
3. Grounded AC electrical outlet

Front Panel



Interface/Powerbase Rear Panel



IV. Suggested Personnel and Training

An adult with proven competency-based training in appropriate use of the oximeter and interpretation of results can perform this procedure safely and effectively. School personnel who have regular contact with the student should receive general training, which covers the students special health care needs and potential problems, as well as how to obtain assistance if problems occur or are eminent.

V. Individualized Health Care Plan

A sample Individualized Health Care Plan (IHCP) and Anticipated Health Crisis Plan are found in Appendix A. These may be copied and used to develop a plan for each student.

Pulse Oximeter

Procedure

1. Select the appropriate probe/sensor and apply it to the student, following directions for use. Connect the probe/sensor to the student and then oximeter.
2. Plug the oximeter into a properly grounded AC outlet using a hospital grade power cord (alternatively, operate the oximeter on its internal battery).
3. Turn on the oximeter using the **on/standby** switch. After a few seconds following successful completion of the self-test, measurements are displayed.
4. Check the alarm limits each time the oximeter is used by sequentially pressing the **high sat, low sat, high rate, and low rate** buttons.

Points to Remember

Tissue damage can be caused by incorrect application or use of a sensor (for example, wrapping the sensor too tightly or applying the supplemental tape). Inspect the sensor site routinely to ensure skin integrity and correct positioning and adhesion of the sensor. If skin integrity changes, move the sensor to another site.

Inspect the sensor and cable for fraying, cracking, breakage, or other damage. If defects are noted, do not use the sensor. Do not immerse sensor completely in water, solvents, or cleaning solutions (because the connector is not waterproof). Do not sterilize by irradiation, steam, or ethylene oxide.

Electric shock hazard. Cover to be removed only by a qualified service personnel. There are not user-serviceable parts inside.

Note: Do not connect to an electrical outlet controlled by a wall switch because power to the monitor could be inadvertently turned off.

The display screen shows the oxygen concentration (it should be in the 90's). An audible beep signals each pulse beat and its pitch increases and decreases to reflect changes in oxygen concentration.

(Sa O₂). If the oximetry pulse signal is lost and pulse is measured only from the ECG, the pulse tone changes from a beep to a warble.

Alarm parameters are ordered by physician.

When the oximeter is turned off and back on, all operator-adjustable features return to their default state.

5. Adjust the alarm limits if necessary. Press and hold the appropriate alarm button, and turn the control knob until the desired value is displayed. SaO₂ alarm limits may be set from 20% to 100%. Pulse rate alarm limits may be set from 20 to 250 beats per minute. The upper limit must be higher than the lower limit.

Do not silence the audible alarm or decrease its volume if student safety could be compromised.

Check the audible alarm silence duration before temporarily silencing the audible alarm.

Inaccurate measurements may be caused by:

- *Incorrect application or use of a sensor.*
- *Exposure to excessive illumination, such as surgical lamps (especially ones with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps or direct sunlight. Exposure to excessive illumination can be corrected by covering the sensor with a dark or opaque material.*
- *Excessive patient movement.*
- *Venous pulsations.*
- *Placement of the sensor on an extremity that has a blood pressure cuff, arterial catheter, or intravascular line.*
- *Placement of the sensor on cold extremity or with low perfusion (circulation)³¹*

**Pulse Oximeter Use
Skills Checklist**

Student's Name: _____

Person Trained: _____

Position: _____

Instructor: _____

	Demo	Return Demonstration					
	Date	Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure.							
B. Preparation:							
1. Reviews procedure							
2. Identifies where procedure is done							
3. Identifies possible problems & appropriate actions							
C. Identifies Supplies:							
1. Oximeter							
2. Light-sensitive probe							
3. Grounded AC electrical outlet							
D. Procedure:							
1. Assembles equipment							
2. Explains procedure to student and encourages participation as appropriate							
3. Selects appropriate probe/sensor							
4. Applies it to student and follows manufacturers directions for use							
5. Connects the probe to the student's appropriate extremity and oximeter							
6. Plugs the oximeter into properly grounded AC outlet							
7. Turns on the oximeter using the ON/Standby switch							
8. Makes sure measurements are displayed							
9. Checks the alarms, making sure the limits are set correctly							
10. Adjusts the alarms if necessary							
11. Documents procedure							

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Checklist content reviewed by :

Parent/Lawful Custodian

Date

USE OF MECHANICAL VENTILATORS

This section provides a general overview of basic ventilator terminology, appropriate personnel, and possible problems and emergency management. It is not intended to be used as a comprehensive reference for ventilator management for an individual student. Several such manuals are available. See Suggested Readings on page 315. In addition, it is essential to obtain student-specific information for each student from the appropriate medical providers.

PURPOSE

Mechanical ventilation is used to sustain life when a person is unable to breathe sufficiently on his or her own. Students with conditions such as neurological damage, muscle weakness, and severe pulmonary disease may need ventilator assistance.

The ventilator or respirator is a machine that can be used to provide total respiratory support for a person who is unable to breathe independently. A ventilator also may be used to assist a student who is able to breathe but whose respiratory ability is inadequate. Some students may require a few breaths a minute in addition to their own or positive end expiratory pressure (PEEP) to keep the lungs open. Other students require full respiratory support for a prescribed period of time during the day or night for rest.

Many different types of ventilators are used, depending on the student's size, the student's medical condition, and the preference of the student's physician. The most common basic type of ventilator is a *positive pressure ventilator*. This machine breathes for a person by pushing air or oxygen-rich gas into the lungs, usually through a tracheostomy tube. This type of ventilator can be relatively small and portable.

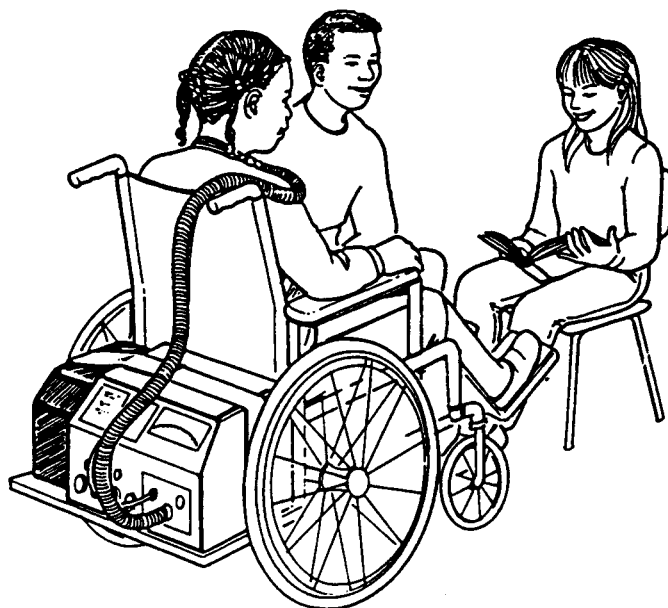
A *negative pressure ventilator* pulls air into the lungs by pulling the person's chest wall outward as the person lies in a vacuum chamber. There are various negative pressure ventilators, including the iron lung, the *raincoat*, and other portable home devices. Negative pressure ventilators are only recommended for people with specific conditions such as muscular weakness. A tracheostomy tube is not required with negative pressure ventilators.

Portable ventilators are usually mounted on the bottom shelf of a wheelchair. The battery is partitioned away from the ventilator in case battery fluid begins to leak.

SUGGESTED SETTINGS

In many cases, the ventilator must be with the student in school and in the transportation vehicle. All settings always should have available grounded electrical outlets and a back-up power source.

Any student who travels to school with a ventilator must carry with him or her a "go bag" containing a manual resuscitation bag, a spare tracheostomy tube, and suction supplies. See "go-bag" checklist on page 355. 33

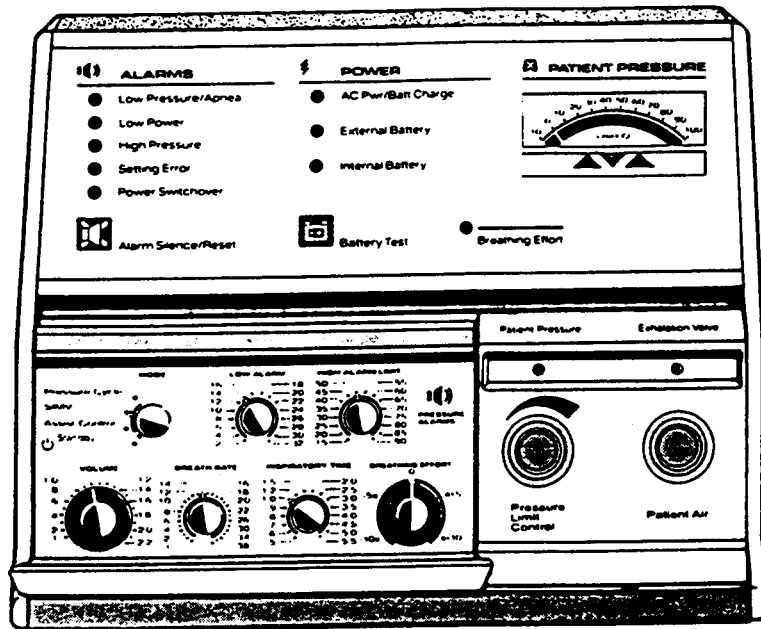


- | | |
|--|--|
| <p>3. Humidification source:</p> <ul style="list-style-type: none"> • Passive condensor • Heat/moisture exchanger | <p><i>Any student who has his or her nose and mouth bypassed by a tracheostomy tube needs a humidifier. Always remember to have an adequate amount of water in the humidifier and have it set at a safe temperature. Some students may use a heat-moisture exchanger for humidification.</i></p> |
| <p>4. Patient pressure manometer</p> <p>5. Ventilator circuit:</p> <p>Tubing and spare tubing required:</p> <ul style="list-style-type: none"> • Pressure tubing | <p><i>The ventilator circuit consists of the tubing that is attached to the ventilator and the student's tracheostomy tube, and other components such as the humidifier and the exhalation and PEEP valves. The tubing carries the air from the ventilator to the student.</i></p> |
| <p>Valves:</p> <ul style="list-style-type: none"> • Exhalation valve • PEEP valve • Other adapters needed for a particular student plus spares of each | <p><i>Caution should always be taken not to block or obstruct the exhalation valve with the student's clothing.</i></p> <p><i>Ventilator circuit maintenance: The cleaning of ventilator circuits should be done at home daily or as needed.</i></p> |
| <p>6. Alarms:</p> <ul style="list-style-type: none"> • High and low pressure • Volume • Power source | <p><i>Alarms should never be turned off. All ventilator alarm settings should be written on the emergency card posted on a visible side of the ventilator.</i></p> |
| <p>7. Other equipment that should be checked daily:</p> <ul style="list-style-type: none"> • Manual resuscitator bag and adapter or mask • Spare tracheostomy tube and supplies • Suctioning equipment • Saline dosettes | <p><i>Each student who travels to school with a ventilator should have a "go bag" containing all of these supplies.</i></p> |

IV. Suggested Personnel and Training

A health assessment must be completed by the school nurse. State nurse practice regulations should be consulted for guidance on delegating health care procedures.

Ventilator care should be performed by a qualified registered nurse or respiratory therapist with proven competency-based training in appropriate techniques and problem management, unless state medical and nursing practice standards specify otherwise. Any other health professional caring for a student assisted by a ventilator should have taken a competency-based training program. ³⁵



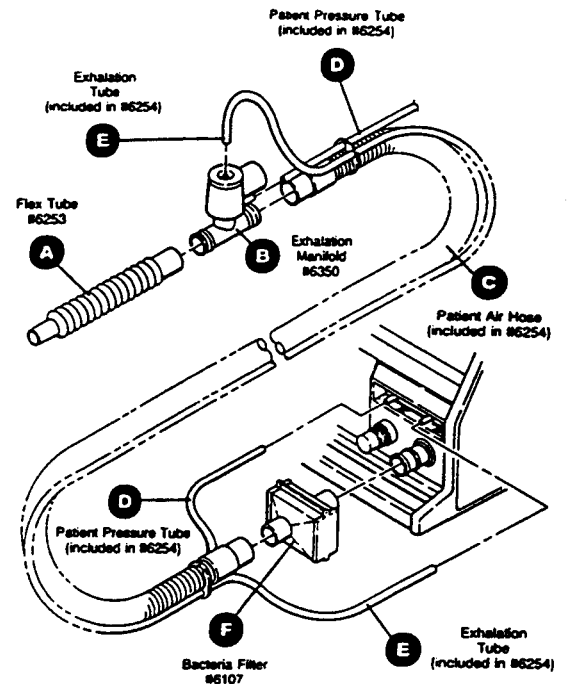
Ventilator Features

1. Power source:

- Internal battery
- External battery
- Accessible, functioning electrical outlets
- Back-up battery
- Emergency power supply

2. Oxygen source:

- Connection to ventilator and spare tubing
- Adequate supply of oxygen, spare tank and gauge



Patient Ventilator Circuit

Points to Remember

Must be connected for machine to function.

The internal battery is generally a 12V DC battery intended for emergency use only.

The external battery is connected to the ventilator via a cable. If fully charged it will operate for approximately 10 hours. The back-up battery is usually kept at home.

An oxygen source may be included, if prescribed for the student.

Oxygen may be supplied in gas or liquid form.

Ensure adequate supply of oxygen is available for the day. Identify flow in liters per minute (LPM) and percentage of oxygen.

Providing educational services to a student assisted by mechanical ventilation is a complex and challenging commitment. There are various health care delivery service models, and some utilize nonmedical personnel to provide ventilator care.

All caregivers should:

- Be aware of state nurse practice acts that may specify care delivery and delegation issues.
- Be trained in student-specific ventilator procedures due to the technical and unique nature of care.
- Be immediately available to the student who is dependent on mechanical ventilation in all school environments, including the classroom and transportation vehicle.
- Understand the amount of assistance each student requires from the ventilator.
- Know specialized cardiopulmonary resuscitation for students with tracheostomies.

If the trained care-giver and back-up personnel are unavailable on a given school day, the student should not attend school. However, an optional agreement may be made between the school and the family where the lawful custodian would attend school to function as the care-giver for the student.

V. Individualized Health Care Plan: Issues for Special Consideration

Each student's Individualized Health Care Plan (IHCP) must be tailored to individual needs. The following section reviews information about ventilator use, and possible problems and emergencies that may arise. It is essential that this section and a reference for the specific ventilator used be reviewed before writing the IHCP.

A sample IHCP and Anticipated Health Crisis Plan are found in Appendix A. These may be copied and used to develop a plan for each student. For a student who requires the use of a ventilator, the following items should receive particular attention:

- Student's underlying condition and the possible problems arising from the condition or treatment
- Student's degree of ventilator dependency
- Student's ability to request assistance
- Signs and symptoms of respiratory distress (e.g., cyanosis, agitation)
- Student's baseline status (e.g., usual ventilator settings, respiratory rate, color, lung sounds, pulse)
- Student need for a highly skilled care-giver with him or her in the classroom and the transport vehicle
- Ventilator settings checked every 1-2 hours
- Back-up power supply should be available at all times (e.g., battery or generator)
- Latex Allergy Alert (See pp. 5-7 of "Allergies" section).
- Universal Precautions. (See Appendix B).

PROCEDURE FOR CHECKING VENTILATOR PARAMETERS

PROCEDURE

Ventilator procedures are prescribed settings for a given student and should be checked several times during the day—every 1–2 hours or more frequently if the student's status changes.

1. Tidal volume
2. Respiratory rate
3. Oxygen percentage
4. Peak inspiratory pressure (PIP)
5. Positive end expiratory pressure (PEEP)
6. Ventilator mode
7. Inspiratory time ("I" Time)
8. High-pressure alarm
9. Low-pressure alarm
10. Power source alarm
11. Temperature alarm

POINTS TO REMEMBER

A safety card, stating the student's ventilator settings, should be mounted on the ventilator and easily visible.

The amount of air in each breath. Determined by the student's size.

Number of breaths delivered in a minute.

Determined by student's condition and size.

Percentage is based on the individual student's needs. (Room air is 21%.)

The amount of pressure required to inflate the lungs to the prescribed tidal volume.

The amount of pressure needed to keep the lungs from totally collapsing after exhalation.

The type of respiratory support administered to the student: intermittent mandatory ventilation (IMV), assist-control, or synchronized intermittent mandatory ventilation (SIMV).

The prescribed mode will be determined by the student's condition and respiratory ability.

The amount of time in the vent cycle used to deliver a breath.

Reflects an excessive inspiratory pressure. May indicate increased resistance or obstruction.

Indicates a too-low inspiratory pressure. Warns of a leak in the system; may signal that adequate volume is not being delivered.

Indicates a change in power. Alarms should never be turned off.

The majority of home care ventilators do not have temperature alarms built into the humidifier unit. The temperature of inspired gas can be checked with an in-line thermometer. 36

PROCEDURE FOR CHECKING VENTILATOR FEATURES

PROCEDURE

Standard ventilator features that should be checked at least daily and on arrival at school. Check the following:

1. Power source:
 - Internal battery
 - External battery
 - Accessible, functioning electrical outlets
 - Back-up battery
 - Emergency power supply
2. Oxygen source:
 - Connection to ventilator and spare tubing
 - Adequate supply of oxygen, spare tank, and gauge
3. Humidification source:
 - Passive condensor
 - Heat-moisture exchanger
4. Patient pressure manometer
5. Ventilator circuit:

Tubing and spare tubing required:

 - Pressure tubing

Valves:

 - Exhalation valve
 - PEEP valve
 - Other adaptors needed for a particular student plus spares of each
6. Alarms:
 - High and low pressure
 - Volume
 - Power source
7. Other equipment that should be checked daily:
 - Manual resuscitator bag and adaptor or mask
 - Spare tracheostomy tube and supplies
 - Suctioning equipment
 - Saline dosettes

POINTS TO REMEMBER

Must be connected for machine to function.

The internal battery is generally a 12-volt DC battery intended for emergency use only.

The external battery is connected to the ventilator via a cable. If fully charged, it will operate for approximately 10 hours.

The back-up battery is usually kept at home.

An oxygen source may be included, if prescribed for the student.

Oxygen may be supplied in gas or liquid form. Ensure adequate supply of oxygen is available for the day. Identify flow in liters per minute (LPM) and percentage of oxygen.

Any student who has his or her nose and mouth bypassed by a tracheostomy tube needs a humidifier. Always remember to have an adequate amount of water in the humidifier and have it set at a safe temperature. Some students may use a heat-moisture exchanger for humidification.

The ventilator circuit consists of the tubing that is attached to the ventilator and the student's tracheostomy tube and other components such as the humidifier and the exhalation and PEEP valves. The tubing carries the air from the ventilator to the student. Caution always should be taken not to block or obstruct the exhalation valve with the student's clothing.

Ventilator circuit maintenance: The cleaning of ventilator circuits should be done at home daily or as needed.

Alarms should never be turned off. All ventilator alarm settings should be written on the emergency card posted on a visible side of the ventilator.

Each student who travels to school with a ventilator should have a "go bag" containing all of these supplies.

POSSIBLE PROBLEMS WHEN USING A VENTILATOR THAT REQUIRE IMMEDIATE ATTENTION

Observations

Student appears to be in distress:

- Increased shortness of breath
- Agitation
- Blueness or pallor of lips, nailbeds
- Retractions (e.g., pulling in of chest muscles)
- Confusion
- Rapid or pounding pulse

The tracheostomy tube is dislodged

The tracheostomy tube is blocked

The student has increased secretions

The student is wheezing

The student continues to be in distress or becomes unconscious

Distress is relieved by disconnecting from ventilator and using manual resuscitation

The power supply is not functioning

Reason/Action

*Immediately check and reassure the student. Call for assistance. **Never leave the student alone.***

The symptoms may be caused by

- Occlusion of the tracheostomy tube by a plug or secretions
- A dislodged tube or other airway problems
- Student may be coughing or doing something else to raise pressure transiently

The symptoms may also be caused by a ventilator malfunction:

- The exhalation valve may be obstructed.
- The student may be disconnected from ventilator.

Check to see that the power source is functioning and that oxygen supply is adequate.

Disconnect the student from the ventilator and use manual resuscitator bag if needed while attending to the student's needs.

Replace the tube.

Attempt to suction; instill saline if indicated. If unsuccessful, replace tube.

Suction the tracheostomy.

Administer bronchodilators by nebulizer if ordered and suction as necessary.

*Continue using manual resuscitator and **activate emergency procedure.***

*Check the ventilator while using the manual resuscitator to assist the student's breathing. Check circuit, valves, and tubing for leaks, obstruction, or water condensation in tubing. If unable to locate and correct problem with ventilator, continue using resuscitation bag and call the home care company, family, and other health care providers as specified in student-specific guidelines. **Activate emergency plan.***

Ventilate student with manual resuscitator until back-up power supply is in operation.

An alarm is activated:

- Low-pressure alarm/apnea alarm is a continuous audible alarm and is usually accompanied by a flashing red light on the ventilator front panel.

- High-pressure alarm is an intermittent alarm usually accompanied by a flashing red light.

Note: If the condition that caused this alarm to be triggered is stopped with the next breath, the audible alarm will stop but the visual alarm will need to be reset.

- Power alarm is **continuous** usually accompanied by a flashing light as well.

Always check student first. Remove the student from ventilator and give breaths with resuscitator bag and then check the ventilator.

This alarm may be activated by the following:

- The student may be disconnected from the ventilator.
- The exhalation valve is not working (wet or punctured).
- The tracheostomy tube is no longer in place.
- The circuit tubing is no longer attached or is loose.
- Water is present in pressure or exhalation tubing.
- Humidifier is improperly attached or leaking.
- Accidental change in ventilator settings.

Test system after cause of problem is found and fixed. Place student back on ventilator.

Always check student first, remove the student from ventilator and give breaths with resuscitator bag and then check ventilator.

This alarm may be activated by the following:

- The student may need to be suctioned for secretions or a mucus plug.
- This may indicate increased resistance or obstruction.
- The circuit tubing may be blocked by water or pinched off.
- The exhalation valve may be obstructed.
- The tracheostomy tube may be out of alignment.
- The student may be coughing or doing something else to raise pressure transiently (i.e., sneezing, talking, laughing).
- Accidental change in ventilator settings

Test system after cause of problem is found and fixed. Place student back on ventilator.

Check to see that power source is functioning (e.g., ac power, internal and external battery). The alarm may sound if power source is interrupted (e.g., power failure, battery change). If all three power sources fail, remove student from ventilator. Give breaths with resuscitator bag and activate the emergency plan.

General Information Sheet

Students Who Use Mechanical Ventilators

Dear (teacher, lunch aide, bus driver):

_____ [Student's name] has a condition that requires a ventilator (i.e., breathing machine). This machine helps a person breathe by pushing air into the lungs. A student who uses a ventilator usually has a tracheostomy tube—a tube that has been surgically placed into the windpipe in the neck. This tube is attached to the ventilator by soft plastic tubing. Ventilators need a battery or other power source to function. The ventilator must be with the student at all times, including during transportation.

A team including the student's family and educational and health personnel will develop a specific health care plan for the school. Classroom issues, such as the accommodation of health care during the day with minimal disruption of the class; feeding issues; and the avoidance of infectious exposures, such as colds, will be addressed in the care plan.

The student will have a caregiver with him or her at all times. This person will be trained to manage the ventilator and care for the student.

The following staff members also have been trained to deal with any problems that might arise:

All staff who have contact with students who use ventilators should be familiar with the emergency plan and how to initiate it in their setting. It is recommended that they participate in cardiopulmonary resuscitation training with specialized training for tracheostomies.

For more information about ventilators, tracheostomies, or the student's needs, consult the school nurse or the family. ³⁷

Student's name: _____

Person trained: _____

Position: _____

Ventilator Machine and Circuit Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Describes machine components and settings:							
1. Power source							
a. Internal battery							
b. External battery							
c. Accessible, functioning electrical outlets							
d. Back-up battery							
e. Emergency power supply							
2. Oxygen source (if needed)							
a. Connection to ventilator and spare tubing							
b. Oxygen supply, spare tank, and gauge							
c. Flow (LPM) and percentage of oxygen							
3. Humidification source:							
a. Passive condensor							
4. Volume							
5. Rate							
6. Patient pressure manometer							
7. Peak inspiratory pressure (PIP)							
8. Positive end expiratory pressure (PEEP)							
9. Ventilator mode							
10. Inspiratory time							
11. High-pressure alarm							
12. Low-pressure alarm							
13. Power source alarm							
C. Describes circuit components:							
1. Patient pressure tubing							
2. Patient port							
3. Exhalation valve							
4. PEEP valve							
5. Additional adaptors							
D. Go-Bag supplies (see p. 355), including:							
1. Manual resuscitation bag with adaptor or mask							

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(continued)

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Ventilator Machine and Circuit Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
2. Spare tracheostomy tube and supplies							
3. Suctioning supplies							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

Student's name: _____

Person trained: _____

Position: _____

Ventilator Troubleshooting Alarms Skills Checklist

Instructor: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
A. States name and purpose of procedure							
B. Steps:							
1. Identifies which alarm is sounding							
2. Checks student first if <i>low-pressure</i> alarm sounds							
3. Removes student from ventilator and gives breaths with resuscitator bag							
4. Checks for leaks, if student is fine:							
a. Student disconnected							
b. Disconnected tubing							
c. Kinked tubing							
d. Punctured tubing							
e. Water in exhalation valve							
f. Hole in exhalation valve							
g. Loose-fitting heater humidification source							
h. Check ventilator settings							
5. Tests system after leak is found (Occlude student end of circuit and wait for high-pressure alarm to sound.)							
6. Places student back on ventilator							
7. Checks student first if a <i>high-pressure</i> alarm sounds							
8. Checks activity of student:							
a. Needs suction							
b. Blocked tracheostomy tube							
c. Coughing							
d. Sneezing							
e. Talking							
f. Laughing							
g. Crying							
h. Hiccups							
i. Body position							
j. Holding breath							
9. Suctions, if needed							
10. Realigns or changes tracheostomy tube, if needed							
11. Removes student from ventilator and gives breaths with resuscitator bag							

(continued)

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Ventilator Troubleshooting Alarms Skills Checklist

Student's name: _____

Explanation/Return Demonstration	Expl./ Demo. Date	Explanation/Return Demonstration					
		Date	Date	Date	Date	Date	Date
12. Checks ventilator for obstructions, if student is okay:							
a. Kinks in tubing							
b. Water in tubing							
c. Blocked exhalation valve							
d. Accidental change in ventilator settings							
13. Places student back on ventilator once problem is solved after checking high-pressure circuit							
14. Checks the following if <i>power source</i> alarm is on:							
a. AC power							
b. Internal battery							
c. External battery							
15. Removes student from ventilator if all three systems fail and <i>gives breaths with resuscita- tor bag</i>							
16. If bagging is required for longer than 15 minutes, adds drops of saline for humidity or puts passive condensor on resuscitation bag and continues to bag; follows emergency plan							

Checklist content approved by:

Parent/Guardian signature _____ Date _____

NOTES

1. Information in this section reprinted by permission from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S., (1997). *Children and youth assisted by medical technology in educational settings: Guidelines for care* (2nd ed), Baltimore: Paul H. Brookes Publishing Co. All rights reserved. (Please refer to individual notes throughout this section for details concerning specific passages of text).

2. Information on pages 1-9 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp 257-259, 301-306).

3. Information on pages 10-11 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program. (1987). *Getting it started and keeping it going: A guide for respiratory home care of the ventilator assisted individual*. New Orleans, LA.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J.S. (pp. 372-373).

4. Information on page 20 of this section adapted from:

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5. Information on pages 21-24 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 295-300).

6. Information on page 25 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (p. 372).

7. Information on pages 26-27 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 296-297).

8. Information on pages 28-29 of this section adapted or reprinted from:

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Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 369-370).

9. Information on pages 30–44 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 271-285).

10. Information on pages 45–47 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 358-360).

11. Information on pages 48–53 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 286-291).

12. Information on pages 54–55 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 356-358).

13. Information on pages 56–62 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 361-362 & 364-368).

14. Information on pages 63–65 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 292-294).

15. Information on pages 66–67 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 355 & 363).

16. Information on pages 68–73 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 260-263 & 269-270).

17. Information on pages 76–77 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 351-352).

- Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (p. 353).
19. Information on page 81 of this section adapted or reprinted from:
- Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.
- Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (p. 354).
20. Information on pages 82-83 of this section reprinted from:
- Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J.S. (pp. 264-265).
21. Ibid. (p. 266). Page 84 of this section.
22. Information on page 85 of this section adapted from:
- Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.
23. Information on pages 86-87 of this section reprinted from:
- Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J.S. (pp. 267-268).
24. Information on page 88 of this section adapted from:
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25. The illustration on page 89 of this section adapted by permission from:
- Heathdyne Technologies. (1992). *Home Manual for the Model 900 Apnea Monitor*. Catalog number 902, (Revision A). Heathdyne, Inc. (p. 4).
26. Ibid. (p. 12). Illustration on page 91 of this section.
27. Ibid. (p. 14). Illustrations on page 92 of this section.
28. Ibid. (pp. 4-14).
29. Information on page 94 of this section adapted from:
- Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.
30. The illustrations on page 95 of this section adapted by permission from:
- Nellcor, Inc. (1994). *Operator's Manuel, Nellcor®N-200. Pulse Oximeter*. Nellcor Puritan Bennett, Inc. (pp. 16 and 18).

31. Ibid. (p. 21)..

32. Information on page 99 of this section adapted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

33. Information on page 100 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 307)

34. Illustrations on page 101 of this section reprinted by permission from:

Aequitron Medical, Inc. (1994). *LP6 Plus Volume Ventilator - And - LP10 Volume Ventilator with Pressure Limit, User's Manual*. Minneapolis, MN. (pp. 4 and 6).

35. Information on pages 101-102 of this section reprinted from:

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 310)

36. Ibid. (pp. 308 & 311). Pages 103-104 of this section.

37. Ibid. (pp. 310, 312-314). Pages 105-108 of this section.

38. Information on pages 109-112 of this section adapted or reprinted from:

Children's Hospital Chronic Illness Program, Ventilator Assisted Care Program.

Porter, S., Haynie, M., Bierle, T., Caldwell, T.H., & Palfrey, J. S. (pp. 374-377).